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CONTENTS.

Editorials 703
New York Electrical Society Meeting 706
Conference on the Conservation and Utilization of Water-Power 706
Meeting of New York Companies Section N. E. L. A. 706
New York Electrical Show 706
Licensing Professional Engineers 707
New Freight-Distributing Yards in Chicago May Hasten Electrification. 707
Toledo Electric Lighting Rates 707
Grounded Secondaries in Denver 708
Relation of Patents to Pooling Agreements 708
Resuscitation from Electric Shock 709
Modern Transmission Problems 709
Use and Maintenance of Joint Pole Lines 710
Influence of Glare on Effective Illumination 711
Transmission and Distribution Systems in Chicago 711
Minnesota Electrical Association at St. Paul 712
Electrification of Steam Railroads 714
Investigation Into Value of Telephone Properties in Seattle, Wash. 715
Rate Question as Affected by Competing Telephone Companies in Chicago 716
Public Utilities Before California Legislature 716
Hearing on Massachusetts Municipal-Ownership Bills 716
Commission News 717
Current News and Notes 718
Electrification of the Pullman Passenger-Car Shops.—I. By George W. Cravens 723
Protection Afforded by Arcing Rings on Transmission Lines. By L. C. Nicholson 727
Transmission Line Troubles 727
Concerning American Wireless Engineering. By O. C. Roos 729
Electricity in Farming in Sweden 731
A Typical Small Central Station 731
Upkeep Costs of Electric Pleasure Vehicles 732
Central-Station Expert to Instruct Electric Truck Operators 732
Natural Ice Shortage Increases Activity in Artificial Product 732
New Branch Office of the New York Edison Company 733
Securing a Summer Motor Load in a Large Mansion 734
The Lighting of a Small Room 735
Ornamental Exterior Lighting on Federal Building, Chicago 736
Recent Telephone Patents 736
LETTER TO THE EDITOR:
Vector Notation. By Charles P. Steinmetz 737
Digest of Current Electrical Literature 738
Book Review 741
New Apparatus and Appliances 741
Financial and Commercial News 747
General News 751
Weekly Record of Electrical Patents 758

NEW YORK ELECTRICAL SOCIETY.

Last week the New York Electrical Society, the oldest body of the kind in this country, held its three hundredth public meeting, devoted very opportunely to electrical development in Mexico and very appropriately convened in the beautiful hall of the Hispanic Museum. The society has had a career of uninterrupted usefulness and is to be congratulated on its vigor and its prosperous outlook. Established definitely in 1881, it now enters upon its fourth decade with the same characteristics that have always marked it. Never a publishing society, it has made a feature of visiting and debating, and has aimed to interest and instruct the younger men in the field. Although a local body, it has had a line of presidents almost equal in caliber to that of the Institute, and has been served throughout with intelligent devotion by its officers, particularly the secretary and the treasurer. Quick to recognize the fact that few topics are now without some relation to electricity, the society has of late in its constitution and practice so modified its program as to embrace matters of widest range in the sciences and arts, and is now finding in this way a field of unsuspected utility and value to a very large class in the community that wants themes treated "popularly," but also precisely and accurately. The highly successful course of meetings this year is a very good illustration of just how to do it, and we can but commend heartily the wisdom and breadth of view thus manifested in the selection of topics and speakers. The society will, we trust, long enjoy a career of such efficient service in the city whose name it bears and in the advocacy and promotion of electricity. Amid the upgrowth of other societies it holds its own with a definite place, a distinct mission and a growing membership.

THE PATENT SITUATION.

Elsewhere we print an excellent exposition of the patent law situation, which is particularly worthy of attention as coming from one of the leaders of the American patent bar, Mr. Charles A. Brown, of Chicago. The chaotic condition now existing in this branch of jurisprudence is well illustrated by the citations which Mr. Brown gives of patent decisions. After reading these citations one cannot but long for the appearance on the scene of a Jeremy Bentham, or, in lack of such a great personal force, at least earnestly hope for early action by Congress on the measure before it constituting a Patent Court of Appeals. But even such a court, however ably manned, would not in itself be able to modify fundamentally the patent situation which has grown up during the period of great industrial development extending over the past quarter century. While the direction, if not extent, of this development has been largely influenced by the patent element, the patent system has in turn been scarcely less influenced, particularly as relates to the great change in the status of the actual inventor. The remedy appears rather to lie in the direction of a complete statutory overhauling of the entire existing body of patent law,

accompanied by such a definition of the patent monopoly that two courts cannot in the future hold such diametrically opposite opinions as those, for example, expressed by the United States Court of Appeals in the seventh and in the third circuit, cited by Mr. Brown. It certainly indicates an extraordinary condition to find on the one hand judges holding that the patent monopoly is as absolute as a royal grant of privilege in France prior to the French Revolution, and, on the other hand, judges who would so closely regulate the use of patents as largely to deprive them of their constitutional character as monopolies.

It is to be noted that the former view is the older one, and descended from the period when the inventor himself received more or less directly the monetary benefit involved in his invention; while the "insurgent" view is of more recent origin, coinciding with the change in industrial conditions under which the patentee is usually a salaried employee enjoying no property right in his work. This latter period also marks the gradual passing of the typical inventor of by-gone days, who was inspired with the ambition of founding or revolutionizing an art, or sustained in his work by visions of wealth to come as a reward for privations undergone while pursuing his ideal. Under the conditions of modern manufacturing organization and standardization of product, the inventor of revolutionary type is apt to meet with least encouragement where he most expects it; and, with protective patents covering many of the important arts, the commercial realization of even a fundamental invention in such arts would involve litigation so expensive and so uncertain in final result that, regardless of intrinsic merit, capital would turn a deaf ear to the inventor.

The foregoing naturally leads up to the inquiry: Upon what foundation has the great patent structure of to-day been reared? By what fundamental criterion can the stability of that structure be measured? The answer to both questions appears to lie in the following quotation of the clause of the Constitution of the United States which established the patent monopoly: "The Congress shall have power to promote the progress of science and useful arts by securing for limited times to authors and inventors the exclusive rights to their respective writings and discoveries."

AMERICAN WIRELESS ENGINEERING.

Although wireless-telegraph waves, if they could only be encouraged to carry around the world, might be expected to make a complete circuit in less than one-seventh of a second, and although with relatively sluggish wire telegraphy the victory of Manila Bay was announced to Washington by local time before the battle occurred, yet it takes many weeks by mail to the more distant islands of the Philippine group before our readers there can comment upon our publications. This week we print a comment by Mr. O. C. Roos upon an article that appeared in our issue of Sept. 29 last. The article in question was a little hard upon American wireless-telegraph engineers, as we commented editorially at the time, and Mr. Roos takes up the cudgels in their defence. There is doubtless much force in his contention. The time is rapidly approaching, however, when the world will be too small to be separated into different countries. What with wireless telegraphy itself, the ever increasing tide of commerce, travel, shipping, tunnels, the mail and the aeroplane, languages themselves will have a struggle for existence, and, in the civilized world, men will tend to lift mountains and dry oceans until in applied science all advance will be made collectively.

TRANSMISSION-LINE TROUBLES.

A correspondent this week gives a heartfelt account of the asperities of energy transmission from the standpoint of the fellow who purchases the energy at the receiving end of the line. His story is a tale of woe for which ample sympathy will be extended by some of his fellow sufferers. The situation described was certainly an unpleasant one—that of a plant carrying a city lighting contract and a large amount of miscellaneous service and buying energy from a long-distance transmission plant apparently afflicted with about all the ills that transmission plants are heir to. The record of interruptions of service for a single year ran to 120, most of them short, but nevertheless aggregating ninety hours of suspended operations. This is a much worse record than would be shown by most plants engaged in transmission business, but happily the record is one of several years ago and has been lived down by progressively improved service. The fact is unfortunately that, while short interruptions of half a minute or a minute or two do not look bad upon the record, they are peculiarly exasperating to the station operator and sometimes become unpleasantly numerous. They are quite long enough to throw synchronous apparatus out of step, interfere with the lighting service in a very exasperating way and cause all manner of kicks from the ultimate consumers. It is a fact, however, as our correspondent states, that most of these interruptions are due, not to failure of service at the generating station nor to the breaking down of the main transmission line, but to the failure of subsidiary apparatus and of branch lines. As a rule a good deal of money is spent on the main lines and they are fairly well protected against lightning by grounded guard wires and banks of lightning arresters. Structurally they are generally first class, and the actual breaking down of a main transmission line is a rather rare accident. Troubles come chiefly on branch lines where the main-line construction is not duplicated and in subsidiary apparatus of various kinds. These are the things that require more careful attention than they generally get. Every branch line is a weak spot and should be strengthened accordingly. Its junction with the main line is quite likely to be a point of electrical disturbance and needs to be guarded accordingly. The branch itself, if operated at main-line voltage, requires main-line construction and insulation. A punctured insulator on a branch is just as bad as if it were on the main line, and there should be no reduction of the factor of safety merely because the branch is a short one. In the case here cited not even the installation of a duplicate transmission line remedied the difficulties, since the same storm would occasionally interfere with both lines and put the receiving plants temporarily out of business.

We fancy that if the solemn truth were told the records of interruption on many transmission lines would not make pleasant reading, yet it is certainly true that some of them, by the exercise of eternal vigilance, succeed in getting through the year with remarkably clean records. Many a plant keeps the voltage at its busbars with a continuity that would do credit to a first-class steam-driven central station. In fact, if one could critically examine the record of troubles in sta-

tions of this latter class he would generally find a series of local interruptions of service sufficient to comfort somewhat the operators of transmission systems. The lesson to be drawn from the situation is, we think, chiefly the necessity of rigorous attention to apparently unimportant branch lines and supposedly unimportant details of construction. Automatic protective apparatus for transmission service has not received the attention that is fairly its due. Not infrequently, too, purely local troubles may be reflected back to the system with most unpleasant results. It would often lead to better service were the transmission lines so guarded with cut-outs as to afford pretty complete protection against this particular cause of trouble. By and large, a well-built transmission line as a whole can be made very reliable; but to insure continuity of service the same care that is exercised on the main line must extend clear through the system, including generally the local distributing systems that suffer most keenly in case of failure.

VECTOR NOTATION.

An interesting communication from Dr. Steinmetz will be found in our correspondence columns this week on the vexed subject of alternating-current vectors. Dr. Steinmetz takes the position that the question at issue between the two different existing schools of alternating-current vector representation is not one of rotation, but of notation, and he criticises a former editorial article of ours on this particular. From one point of view Dr. Steinmetz's proposition is unassailable, but from another and equally good point of view it is open to assault. As is usual in such deadlocks of controversy, the dispute arises over the precise subject of disputation, and each party mistakes the contention of its opponent. As we are all most unfortunately aware, vector diagrams appear in alternating-current literature with two mutually inverted representations. If we look at a clock and conceive the hour-hand as denoting a vector e.m.f. impressed upon a simple alternating-current circuit containing a choking coil, or resistance plus reactance, then, in either representation, the hour-hand at 3 o'clock may indicate the e.m.f. vector in the horizontal position of reference or standard phase. If now the minute-hand on the same clock dial represents the alternating current in the circuit, this current will lag, say, 30 deg. behind the impressed e.m.f. One school of vector writers designates this by putting the current or minute-hand on one side of the e.m.f. hand, making the clock read 3:10; while the other school puts the current hand on the other side of the e.m.f. hand, making the clock read 3.20. Consequently, when we see 3:20 on the vector clock face of a textbook page we cannot tell whether it means a lag or a lead of 30 deg. in the current unless we know to which school the writer belongs or gather from the accompanying context, if there be any, which way his diagram should be interpreted. The unfortunate beginner in alternating-current vector notation is apt to be discouraged by this ambiguity and to exclaim with Mercutio: "A plague on both your houses." Electrical engineers should not rest contented until 3:20 means one thing and stands for one phase representation all over the alternating-current world.

It is, of course, admitted, on all hands that both those who represent a lagging current by 3:10 and those who represent it on the contrary, by 3:20 nowadays derive their representation from a fundamental positive or counterclockwise rotation by polar co-ordinate geometry and by trigonometry respectively. If, as Dr. Steinmetz does, we rotate a time vector uniformly counterclockwise and take instantaneous intercepts thereon, and if a simple sinusoidal alternating e.m.f. or current be so graphed, the graph will be a circle. If, further, we adopt the convention with Dr. Steinmetz that the diameter of this circle shall be the fixed vector representing that quantity, then we are led inevitably to 3:10 for a lagging current when both current and e.m.f. are vectored simultaneously. If, on the other hand, we plot a sinusoidal quantity as the ordinary textbook on trigonometry plots it, with a counterclockwise rotating crank diagram, then if we take the direction of maximum positive amplitude as a fixed vector representing the quantity, we are led inevitably to 3:20 for a lagging current, if both current and e.m.f. are vectored simultaneously. From the standpoint, therefore, of fundamental rotation Dr. Steinmetz's contention cannot be disputed that there is no difference between the two schools as to direction of rotation and that the only question is as to how the vectors in question have been derived. From another point of view, however, the two rival vector methods involve different rotations, because in the 3:20 clock face the minute-hand of lagging current is shown as lagging in phase behind the hour-hand of impressed e.m.f. in the order of positive rotation; whereas in the 3:10 clock face the lagging current takes a position ahead of the impressed e.m.f. in the direction of positive rotation. Or, to express the facts in another way, if we look at a clock face and understand that time is to advance counterclockwise we would naturally expect that a vector at 3 would precede a vector at 4, or would be the leading vector. According to the 3:20 school this would be true, but it would be just the reverse with the 3:10 school. From this standpoint the question at issue is one of rotation, that is, rotation in the direction of phase advance.

As to polar co-ordinate plotting versus trigonometrical projection the only advantage that is unchallenged for the polar system is that when a complex harmonic wave is plotted the circle of equal area has a radius that measures to scale the root-mean-square value. On the other hand, the trigonometrical projection method is the one almost invariably used when the complex wave has to be analyzed into harmonic components. Consequently, engineers must be familiar with both methods of plotting. Of course, only one conventional vector diagram representation should be selected and standardized. Whichever diagram is selected by the International Electrotechnical Commission, whether for a lagging current, the 3:10 or the 3:20 clock picture, the result can be harmonized with the other method of plotting by a suitable change in what is mere graphic convention and not fundamental mathematics. Dr. Steinmetz points out that in his heart-shaped polar diagram the five extrema indicate a fifth harmonic. The corresponding trigonometrical projection, however, to rectangular co-ordinates also shows five extrema, and gives a similar indication. We agree very heartily with Dr. Steinmetz that two different representations of alternating vectors exist and that it would be very desirable to reach an agreement on vector notation. We have no fear, however, concerning the possibility of reaching a decision by international discussion and agreement. It is a mere matter of convention and will mean the cessation of a sad brain-wearying dissension that has been running on for nearly a quarter of a century.

New York Electrical Society Meeting.

The three hundredth meeting of the oldest American electrical association, the New York Electrical Society, was held on March 16 at the Hispanic Society Building. Mr. F. O. Blackwell delivered an illustrated lecture on hydroelectric development in Mexico in which he outlined the early plants brought into existence by reason of the excessive cost of fuel, especially in the mining districts. He described briefly the electrical equipment at Guanajuato, and in detail the Necaxa plant of the Mexican Light & Power Company. The equipment at the latter plant has been so far extended recently that 150,000 hp can be developed. The paper was not discussed. The 200 members and guests who were present were afforded an opportunity to inspect the museum of the Hispanic Society, which contains many features of historical interest, including rare paintings, wood carving, silver work, plaque collections, mosaics, ancient manuscripts, ecclesiastical sculpture and various other antiquities.

During a short business meeting of the society the treasurer reported that the heavy load of debt which the society had incurred during the last few years, in its endeavor to develop its work and increase the advantages of its membership, has been paid off, and the finances of the society are now in a prosperous condition. Twenty-eight members and thirty-two life members were elected. The society now has over 800 members.

Conference on the Conservation and Utilization of Water-Power.

A public conference will be held in the United Engineering Building, New York, on Saturday, April 8, under the auspices of the Power Transmission Section of the National Electric Light Association, to consider the important subject of the relation of the national and state governments to the conservation and utilization of water-powers. Two sessions will be held, afternoon and evening, and papers and addresses will be delivered by several well-known men. Invitations to the conference are being sent to members of engineering societies as far east as the Mississippi River, and the meeting has the hearty co-operation of national engineering bodies.

Among the list of topics for discussion are the following:

Shall the federal government continue in control of the water-power sites or transfer them to the respective states wherein they are located?

If the latter, shall they turn them over without reservation or endeavor to impose restrictions?

Shall the water-power sites, whether controlled by federal or state government, be transferred outright to the locaters thereon for a consideration or without a consideration other than that they agree to develop them within a reasonable limit of time; or shall the water-power sites, whether owned by federal or state authorities, be leased to the locaters, and, if so, shall there be a time limit and a basis of charge?

If a charge, shall this charge be an annual rental for the property or based on the possibility of development or the actual development?

If on the actual development, shall the charge be arrived at on the basis of the minimum flow of water, or the actual amount of power generated and delivered therefrom, or the installed capacity in the generating station?

Contemplating, as is generally the situation, that the majority of the water-power sites, whether controlled by either federal or state government, cover only a very small proportion of the property as a whole utilized in the development of these propositions, shall or shall not this feature be taken into consideration in fixing the charges, if any?

If it is thought that it is best to grant a tenure for a definite time limit, what provision should be made in the original agreement as to the basis for renewing the rights to occupy the land?

In adjustment, what consideration should be given to the fact that the individual, company or corporation occupying the site has a positive and individual ownership in the water, which ownership has been acquired direct from the state and in fee simple?

If it is finally concluded that the government should retain ownership in the land, granting only an easement with a time limit and at the end of this time limit either the lease be renewed or the new owners take possession of the property, what provision should be made as to the proper valuation, the latter to include that portion of the development located on the government property, the ownership in the water, the pole lines which are or are not on government land, the substations wherever located, as well as the distributing circuits and motor installations therefrom? Shall they be valued on the basis of a replacement charge or on earning capacity?

Would it not be better that either the federal or the state government, whichever it is concluded should own these sites, should grant them in fee to the parties who will take and develop them within a certain given time and depend upon the public service commissions to regulate the rates and service, the same as is being done now in certain states with street-railway and lighting companies?

Meeting of New York Companies Section, N. E. L. A.

The Edison Auditorium, in West Twenty-seventh Street, New York, was packed to the doors on March 20 to hear Mr. Walter R. Addicks, vice-president of the Consolidated Gas Company, deliver an illustrated lecture on the manufacture and distribution of illuminating gas. Mr. Addicks described the various processes of making water gas, coal gas and coke and the modern methods of ridding the gas of ammonia, tar, sulphur, etc. He described in detail the immense plant of the company at Astoria, Long Island, whence the entire New York system will eventually be supplied. There are located the largest coal gas units and the largest gas holder in the world, the latter having a capacity of 15,000,000 cu. ft. The illuminating gas from this plant is brought to New York by a tunnel under the East River. Mr. Addicks not only enlightened his hearers on a subject with which few were familiar, but also surprised them by showing to what a great extent electricity is employed in the gas works for driving conveyors, charging machines and other apparatus employed in the manufacture of gas. The distribution of the gas to holders in New York, thence to the consumers, and the methods employed for increasing the sale of gas were all treated at length in an interesting way, void of technicalities. The speaker was frank in his admission of the superiority of electricity for illuminating purposes, especially in show windows; but showed the immense use to which gas was put in cooking and heating appliances in New York. Many of the gas stoves are leased to users at nominal yearly rentals ranging from $1 to $3.

Mr. Arthur Williams, chairman of the meeting, stated that the membership of the section had increased in number and was now only surpassed by that of the Chicago Section. It is expected that at the April meeting Mr. Nikola Tesla will give a lecture and demonstration on high-frequency currents. The meeting will probably be held in the Engineering Societies Building, which has a greater seating capacity than the Edison Auditorium. After the lecture and announcements there was an entertainment followed by refreshments. The attendance at the meeting was over 600.

New York Electrical Show.

This year's electrical show in New York City, which will be called the New York Electrical Exposition, will be held in the New Grand Central Palace, Lexington Avenue, Depew Place, Forty-sixth and Forty-seventh Streets, Oct. 11 to 21. The change has been made from Madison Square Garden, where the previous shows have been held, in order to secure greater exhibition space. The main floor of New Grand Central Palace has 100,000 sq. ft. of space available for exhibition purposes as

against 30,000 sq. ft. in the arena of Madison Square Garden, and in addition the two upper floors are more suitable for the purposes in mind. The second floor of the New Grand Central Palace will be given over to manufacturing exhibits, and there will be shown in miniature the entire processes employed in the manufacture of candy, cigarettes, fountain pens, etc. The third floor will be converted into an automobile track with model garage and charging equipments, so as to enable manufacturers of electric vehicles exhibiting on the main floor to show the automobiles in operation. The decorative scheme has not as yet been finished, but a number of decorators are at present engaged in working on plans for beautifying the exhibition structure, for housing the exhibits and to evolve a setting unlike anything heretofore tried in the numerous shows given in New York yearly.

Licensing Professional Engineers.

As previously noted in these columns, a hearing before the committee on general laws of the New York Assembly was held March 1 upon the so-called Hoff bill, which was based upon a draft prepared by a committee of the American Society of Civil Engineers and introduced with the understanding that while the society did not advocate the licensing of civil engineers, if legislation to that effect was imperative the Hoff bill was suggested. Another bill has been introduced at the suggestion of the Technical League and is known as the McGrath bill. This was referred to the committee on public education, and at a hearing held on March 14 the American Institute of Electrical Engineers was represented by Past-president Frank J. Sprague, Messrs. Charles W. Stone, H. H. Barnes, S. D. Sprong, managers; Mr. E. A. Baldwin, chairman of the Schenectady Section, and Mr. Ralph W. Pope, secretary. The National Electric Light Association was represented by Mr. W. W. Freeman, president, and prominent officers and members of the American Society of Mechanical Engineers, American Institute of Mining Engineers and American Society of Civil Engineers were also in attendance, all being opposed to the McGrath bill, which was championed only by the counsel and president of the Technical League.

The statement was made that the league is composed of approximately 1000 members scattered throughout the country, about 250 being employed in the State of New York. The object of the bill was stated to be the elevation of the profession and the protection of the people against incompetent civil engineering in public works. Messrs. Sprague and Stone spoke against the bill in behalf of the American Institute of Electrical Engineers and were supported by President Freeman, of the National Electric Light Association; Col. Meier, president of the American Society of Mechanical Engineers; Mr. Spilsbury, representing the American Institute of Mining Engineers; President Boller, of the American Institute of Consulting Engineers, and Mr. Francis, of the American Society of Civil Engineers. After the hearing it was reported from various sources that the bill was not likely to be pushed in opposition to the practically unanimous disapproval from engineers of standing. Unless engineers are on their guard similar legislation in other states may be adopted detrimental to the interests of engineers, who have heretofore been practically free from interference of this nature. Several states have already enacted legislation of this nature.

New Freight-Distributing Yards in Chicago May Hasten Electrification.

It is said that the railroads entering Chicago are considering the establishment of large freight-distributing yards on the outskirts of that city to combine and systematize the interchange of freight in possibly two or three yards, where nearly thirty yards are now in use scattered along the belt railroad that encircles the city. This plan of outer yards has an important bearing on the proposed electrification of the Chicago railroad terminals. If the freight switching could be done in these yards it would be a comparatively simple matter to electrify the passenger terminals, while the sorted freight cars could be pulled in by electric locomotives.

Railroad officials are reported to have said that the plan of outer distributing yards is conceded to be the solution of the freight problem in case the terminals are electrified. It is declared that the railroads are not willing to admit that they expect to lose in the fight for immediate and universal electrification. The plan of building extensive freight-exchange yards has been in contemplation for years, and to some extent the idea is carried out now. Nevertheless, the fact that the very large expense involved is now considered seriously leads to the belief that the imminence of electrification has brought the plan from the realm of things hoped for to the category of things that will probably be actually accomplished.

Toledo Electric Lighting Rates.

Last week at a meeting of the Council of Toledo a subcommittee report fixing the residence lighting rate at 6 cents per kw-hour, with a minimum monthly charge of 50 cents, was adopted. A discount of 1 cent per kw-hour is to be allowed if the bills are paid within ten days after being rendered. The present rate is 9 cents per kw-hour and a minimum charge of $1 with a discount of 10 per cent.

President Albion E. Lang, of the Toledo Railways & Light Company, was emphatic in a statement that the rate could not be accepted, as it would mean a loss and final confiscation. He said the only thing that could be done would be to cut off those who are at present paying 9 cents and furnish the downtown houses and buildings at 6 cents, which could probably be done with profit.

During the Council meeting Mr. Lang in reply to a question said that the cost of producing electrical energy was between ¾ cent and 1 cent per kw-hour at the switchboard. When asked to give the cost delivered to the consumer he said that the transmission system is so complicated and so many things enter into the cost that he could not give the figures, and added that the company is losing money on the 9-cent rate. The average receipts, it was said, are 3¾ cents per kw-hour.

Attorney Rathbun Fuller called the attention of the committee to the attempt at Columbus to enforce a 5-cent rate five years ago. The city was enjoined from enforcing the ordinance and the United States Court sustained the company in its contention that the rate would be confiscatory. It was shown at that time that the cost of energy to the rush consumer was 5.394 cents, without considering interest and depreciation, and 8.594 cents, including these charges. A rate of 8 cents per kw-hour was finally fixed after the city had expended $26,000 in litigation.

Members of the committee contended that great improvements had been made since that time and that production costs much less now. President Lang said that the progressive ideas of Toledo had greatly increased the cost of production. This city has the sixth largest underground conduit system in the United States, he said, and, with the exception of Boston, it is the only city fully equipped with magnetite street lamps.

Mr. Fuller stated that the statute under which the old franchise was drawn gives the company the right to make its own minimum and meter charge in the absence of any provision relating to these points in the contract. President Lang proposed to the committee that engineers be employed to go over the books of the company and estimate the cost of production and that the rate be based upon this estimate. He said that this is the only equitable manner in which to arrive at anything like a correct figure.

In order to give the public an idea of the situation the company is now running a series of talks in all the Toledo papers. In these talks the company seeks to bring out all the salient points affecting the production of electricity and the benefit to the city in its use for power purposes.

Grounded Secondaries in Denver.

The secondaries of the Denver Gas & Electric Company are now all grounded throughout the city. Several initial grounds on the interconnected secondaries from each primary have been made to water mains direct from the network neutral, and every new or rewired installation is being independently grounded to a water pipe on the street side of the meter. As all new wiring installations in Denver are in iron conduit and all conduit grounded to water pipes by cable at least one-half the size of the largest wire in the building, all that is necessary is a thorough ground of the neutral wire inside the main cabinet. This is required by ordinance.

An additional ordinance requirement, recently effective, prohibits any service connection until the installation is reported ready for service by the city electrician. The service company is now pursuing a careful inspection by a special inspection force of all basements, toilets, kitchens and like places throughout the entire city and mailing notices to owners, occupants and the city electrician of brass shell sockets or cord conditions tending to possible personal injury. These cases will all be followed up and corrections secured by the city department. This is probably the first thorough campaign for safeguarding against personal injury from electric wiring undertaken in this country, and in connection with the requirement for conduit installation in all cases will place Denver in the very first rank in protection of both property and life from electrical accidents.

An unusual degree of co-operation between the city electrician and the service company is responsible for the remarkable advance within some four or five years from the promiscuous interior and exterior wiring methods formerly in vogue and still practised too often in other cities.

Relation of Patents to Pooling Agreements.

At the midwinter dinner of the Electric Power Club in Chicago early this year, as mentioned in these columns at the time, Mr. Charles A. Brown, of the Chicago patent bar, made an address on "The Relation of Patents to Pooling Agreements." Mr. Brown, from his long familiarity with electrical patent litigation and the study which he has given to the situation both as a citizen and as a professional man, is well fitted to discuss this subject of importance. Readers of this journal will be interested, therefore, in the following abstract giving the substance of Mr. Brown's speech.

After referring to the tendency toward price pools and combinations, which is said by some writers to be as fundamental and inevitable in its operation as any law of nature, and which is opposed by a contrary force which seems equally powerful, namely, the public interest in competition, he said that the race between the means adopted for the legal defense of combinations on the one hand and the legal attacking ordnance on the other is something like the race between the progressively increasing resistance of protecting armor of war vessels and the progressively increasing power of the attacking guns.

So far the legal armor of combinations has failed to prove impenetrable to the legal projectiles hurled against it. Contracts, trusts for holding stocks, holding corporations, etc., have been tried with confidence that they would each afford absolute legal safety. But the decisions of the courts, getting more vigorous from the power of public opinion back of them, have penetrated one device after another until now patents are, or may soon be, about the only legal shelter for a combination agreement affecting prices.

By statute the United States gives to an inventor a patent by which he has the exclusive right to make, use and sell his invention for seventeen years. By the statute of July 2, 1890 (Sherman act), every contract, combination or conspiracy in restraint of trade or commerce among the several states is made illegal. Here are two legislative enactments of equal validity. One of them grants a monopoly for a specific time; the other forbids any monopoly based on any contract, combination or conspiracy.

Mr. Brown stated that under the patent law, as it had been interpreted by the courts, the patentee has legal authority to make and sell the invention and to restrict its use in respect of territory, time, business or purpose as he shall deem fit. In the Dorsey Revolving Harvester Rake Company versus Bradley Manufacturing Company case Judge Blatchford says: "The right of the patentee to confer upon others such qualified privilege, whether of making or selling to others or of using as he sees fit, whether within special limits or under limitations of quantity or number of restricted uses, does not seem deniable."

This early enunciation of the law by a celebrated judge has been followed in a long line of decisions which have held that the exclusive right granted by a patent to make, use and sell an invention may be parceled out and distributed among any number of licensees. Under such decisions a patentee may withhold his invention from the public absolutely and completely, and he has the right, extending all the way from this complete exclusion of the public to a complete abandonment of the invention to free use by the public, to name the conditions—any conditions—under which the public may have the benefit of his invention during the seventeen years of the life of his patent.

Mr. Brown stated that it is not disputed that under the law a patentee may license others—no matter how many others—to make, sell or use the invention, and may make the license conditional on the licensees all maintaining a fixed price, and may make such conditions as to the regulation of business and prices as the patentee may deem proper, and that it is not disputed that an individual or a corporation can acquire title to any number of patents, and with respect to each patent so acquired have and exercise all the rights belonging to any patent owner. Such owner would have a right to grant licenses covering them all and prescribing like prices for all the patented articles in all the patents.

It has been held legal for the owner of a patented machine for fastening buttons to shoes to sell such machines subject to a condition that they shall be used only with fasteners manufactured by the seller, title to revert on breach of the condition. Even though the fasteners are not patented and the result of the restriction is to give the owners of the machine patent a monopoly of the manufacture and sale of these unpatented fasteners, still this does not make the condition void as in restraint of trade. (Heaton Peninsular Button Fastener Company versus Eureka Specialty Company.) It has been held that under the patent laws patented articles are not articles of trade or commerce among the several states in which the people are entitled to freedom of trade, nor are they instrumentalities of commerce in which the people are entitled to free competition, nor when restrictions are placed upon the making, selling or using of such articles are the people deprived of anything to which they have a right. (Rubber Tire Wheel Company versus Milwaukee R. W. Company.)

It has been held that where there were a number of licenses without restriction of output or fixing of prices, and where each of the licensees under his license enjoyed a portion of the patent monopoly subject only to the payment of royalty and might freely compete with any other licensee, nevertheless, since the public could not have the patented article except by permission of the licensor or licensees, and, since the licensor had retained a certain interest in the invention, a combination subsequently entered into between the licensor and licensees which restricted output, fixed prices and made other restrictive provisions was valid. (Goshen Rubber Works versus Single Tube A. & P. Tire Company.)

It has been held that independent and competing patents, although representing separate inventions which under separate control might be given to the public in competition with each other, were still not something to which the public was entitled, and consequently the combination of the separate monopolies in one ownership or control by which competition

between them was restrained or destroyed was not in violation of the Sherman act. (Indiana Manufacturing Company versus J. I. Case T. M. Company.)

In holding that the owner of a patent could impose as a condition of the use of a patented machine the provision that it must be sold at a certain price and any violation of that condition made both the seller and user of the machine an infringer, the Circuit Court of Appeals for the Seventh District said: "Within his domain the patentee is czar. The people must take the invention on the terms he dictates or let it alone for seventeen years. This is a necessity from the nature of the grant. Cries of restraint of trade and impairment of the freedom of sales are unavailing because for the promotion of the useful arts the Constitution and statutes authorize this very monopoly."

From the foregoing, Mr. Brown stated, it is apparent that combinations and contracts which otherwise would be obnoxious to the Sherman law become bathed with immunity under the sanctifying influence of the patent law. The other side of the issue is then presented.

It has been repeatedly held that patentees must enjoy their monopolies in obedience to law and the rules of public policy. A patented oil which did not comply with the state law requirement as to test was found not exempt from the provisions of the state law. Patented sewing machines have been held to be taxable under state license laws, and so has patented oleomargarine.

The late Justice Brewer said that "There is no peculiar sanctity hovering over or attaching to the ownership of a patent."

Other courts have set forth the following views:

"The patent laws of the United States give to inventors the exclusive right to their inventions, but do not give to them the right to disregard laws enacted to promote the welfare of the whole people.

"The property of an inventor in a patented machine, like all other property, remains subject to the paramount claims of society.

"The patent laws do not authorize the patentee to employ his invention for a purpose or in a manner that may be forbidden to all other persons in the use of their unpatented property or discoveries."

These are some of the general expressions of courts on this subject, and in National Harrow Company versus Hench the Circuit Court of Appeals for the Third Circuit decided that the owners of or licensees under different patents controlling patented articles of similar use which would compete in the market if such competition were unhindered—like sewing machines, or typewriters, or automobiles—cannot lawfully form a combination under the protection of their patents to uphold their prices; that each patentee has his own monopoly of his own invention, but that two or more patentees cannot unite to form a new monopoly; that the public is entitled to the benefit of competition between articles covered by different patents as well as between different unpatented articles.

It will be seen that there is a direct conflict between the decisions of the different courts upon this subject, and the Supreme Court of the United States has not yet spoken.

No one can say with certainty where the Supreme Court will draw the line. The situation is as between the contending forces something like that which arises where an irresistible force encounters an immovable body. There is bound to be some wabbling. This much, however, Mr. Brown said, can be asserted with some certainty: The perfectly worthless patent employed as a mere cloak to cover a combination cannot save that combination from condemnation under the Sherman law. Under the present law a test of legality may be laid down in the following interrogatory: "Is the arrangement under consideration substantially an exercise of the patentee's right of exclusion, or is it essentially a combination in restraint of trade?"

Where there is a combination to sustain prices of a patented article it is a subject of inquiry whether the real purpose and result of the combination are to uphold and protect a valid patent monopoly or to uphold and protect an unlawful trade monopoly.

Whatever is, in fact, a reservation from the patent grant is legal. Whatever is not a reservation from the grant, but depends on contract, whatever be the form, is likely to be found obnoxious to the Sherman law.

In conclusion Mr. Brown pointed out that there is a consideration which passes beyond the mere question whether or not a combination fixing prices is or is not within the law as it shall be finally settled by the Supreme Court.

Our patent system is the creature of statute. Already we hear grumblings regarding even the undisputed legal monopoly granted by a patent.

Whatever the courts may decide, we may be sure that monopolies protected by the patent law will be trimmed by the legislature, if not by the courts, until they fit easily upon the disposition of the public.

It is not wise, therefore, to strain the protecting force of the patent statutes, but to keep well within the factor of safety, not only with reference to the decisions of the courts, but with reference to possible future legislation.

Resuscitation from Electric Shock.

An interesting case of resuscitation from apparent death caused by electric shock is reported in a recent issue of *Badische Gewerbe Zeitung*, which case was also referred to and discussed by M. d'Arsonval at a recent meeting of l'Académie des Sciences in Paris. In the place where the accident occurred the three-phase wires of a 7500-volt, 55-cycle circuit were placed on a bracket fastened to the wall about 20 ft. above the ground. A lineman had climbed up to this bracket in order to work on some telephone wires and accidentally took hold of one of the high-tension wires. It was several minutes before the line was disconnected, about fifteen minutes before the man was found and half an hour before he was brought to the ground; that is, about fifty minutes elapsed from the time of the shock until the first efforts at resuscitation were made. When brought to the ground the victim of the shock did not give any sign of life, and attempts were made to produce artificial respiration by movements of the arms, etc., principally following the Sylvester method, but without effect. As hope was about to be abandoned it was recalled that instructions relating to the tongue had been neglected, whereupon the mouth was forced open and the tongue pulled out and allowed to recede rhythmically. Almost at once the patient responded and commenced to breathe, and after two hours the man not only had regained consciousness, but, with the exception of a few burns, was in normal condition.

Modern Transmission Problems.

Mr. D. B. Rushmore, of Schenectady, N. Y., delivered an address before the local section of the A. I. E. E. at Pittsburgh on March 14 on some aspects of modern energy transmission.

The speaker began his remarks by referring to the work of the high-tension transmission committee of the Institute and the fact that the art was constantly changing, due to new conditions arising. High-tension systems, a few years ago a novelty, are now very prevalent over the country, particularly prominent ones being located in California, Colorado, Montana, Michigan, Canada, New York, Pennsylvania and North Carolina. Energy transmission formerly meant high-tension systems obtaining energy from waterfalls alone, but now such a system usually consists of a water-power station with steam plants tied in to relay in case of trouble. This has necessitated a change in the design of apparatus to conform to the new requirements. Unfortunately many high-tension systems have proved to be financial failures, and this has been caused in a

large measure by the fact that the market for same has not been controlled. Success depends upon the control of the market. The general tendency now is for the local companies in the district to receive energy to combine, thereby assuring a market for the output, and form a high-tension network.

Another feature tending to discredit these systems is the number of interruptions to which they have been subjected. A few years ago many of these lines now operating continuously were subjected to so many interruptions that it was impossible to rely on the transmitted energy for commercial uses. At the present time, however, the magnitude of the loads carried and the reliance placed by manufacturing industries demand continuity of service. This development has brought about changes in the engineering features of construction, both of the generating and transmission system, resulting in an increased cost per unit. As an example may be noted the replacing of the old wooden flume for carrying the water by a tunnel under the mountain.

The speaker described briefly some of the more prominent high-tension transmission systems, mentioning their distinctive features and showing some illustrations pertaining thereto. He said that the Grand Rapids-Muskegon Power Company, Michigan, which operates at 100,000 volts, experiences no trouble from interruptions. The system operated by the Southern California Edison Company was referred to as the greatest in the world, being veritably a high-tension busbar running the length of the State. When any trouble occurs in one of the power houses it can be immediately disconnected from the system and the others supply the energy. Considerable trouble was experienced at first by reason of spray from salt fog lodging on the insulators. This company is now operating at 100,000 volts and actually experiences less trouble than with the lower voltages. The frequency is 50 cycles. Its use well illustrates the influence on any future developments of a selection made in the beginning. This frequency was selected several years ago, and as the present system is simply an outgrowth of the earlier one the same frequency had to be maintained. The frequency of 40 cycles used by the Hudson River Power Company in eastern New York is another example of this influence.

Different geographical conditions affect the design and operation of systems, as is well illustrated by the Central Colorado Power Company, which operates some of its lines at an altitude of 13,000 ft., crossing the continental divide three times. Some portions of the lines are so inaccessible that in winter it takes from two to three weeks to reach them from the base of supplies.

A feature which promises to be a very important factor in the future development of high-tension transmission systems is that of corona loss, which in some cases on the lines mentioned is as high as 1000 kw. In the opinion of the speaker the study of corona loss is the most important subject now to the fore in connection with high-tension transmission and the voltage will be limited to 150,000 on account of corona loss unless some other form of conductor is used.

A great deal of the success of operation depends on the manner in which the apparatus is placed in the stations. For higher voltages the wiring is usually open, as the large clearance distances required would necessitate inclosing structures of excessive dimensions.

Mr. Rushmore showed a great many lantern slides illustrating various forms of generating, transforming and protective apparatus developed for high-tension service, explaining in brief the special characteristics of each. Generators and transformers are both undergoing radical changes necessitated by new conditions they have to meet. In rating of steam turbines there seems to be no limit—units of 20,000 kw are now being built. In the design of water-wheel-driven generators allowance must be made for a possible increase in speed of 100 per cent should the water-wheel governor become disabled. Another very important point to be considered is the amount of energy capable of being delivered to a short circuit. External reactance coils are now frequently employed to protect the machines by limiting the short-circuit current.

Large apparatus must frequently be constructed so that it can be shipped in small pieces, on account of the lack of proper transportation facilities. For example, generators and switchboards have been transported on mules.

The speaker, in conclusion, predicted a consolidation of the existing systems into a few large syndicates which would operate them advantageously. There seems to be no limit to expansion except the market. The voltage in the near future will not exceed 200,000.

Transmission of energy at high potentials presents a large field for investigation and serious work. The success thus far attained has been, in a great measure, due to the active cooperation between the manufacturers and users of apparatus, the latter realizing that newly developed apparatus must of necessity be thoroughly tested in actual practice before being perfected.

The transmission of electrical energy generated by waterpower which would otherwise be wasted is the most important work engineers of the present day have accomplished.

Use and Maintenance of Joint-Pole Lines.

One of the papers presented at the third annual meeting of the Engineering Society of Wisconsin at Madison, Wis., on March 10 was by Mr. O. M. Rau, chief electrician of the Milwaukee Electric Railway & Light Company, and was entitled "Use and Maintenance of Joint-Pole Lines by Public-Service Companies." Pointing out that the existence of public-service commissions has an important bearing on the question of joint-pole lines, Mr. Rau said that the general tendency of a commission is to bring about elimination of competition. Ultimately this tendency will result, no doubt, in one telephone company, one electric service company and one railway company in a community, with a possible consolidation of the latter two. With the elimination of direct competition the value of the pole-line right on streets is of little importance, and a more favorable feeling should exist toward a policy of joint-pole construction and maintenance.

The writer's object was to point out a standard method which may be adopted for joint-pole ownership and maintenance between different companies. The pole line for the light and power company should receive first consideration on account of the high potentials carried on its transmission lines. The poles for this service should be of good quality and not less than 35 ft. high. They should be rigidly set and suitable for the mounting of transformers. Upon the top cross-arms the high-potential transmission lines should be placed. Next come cross-arms required for arc-lighting circuits and below them the cross-arms for the distributing system. This will bring the lowest cross-arm not less than 20 ft. above the ground. Poles should be spaced from 100 ft. to 125 ft. apart.

With the lighting and power lines so installed that portion of the pole not used will meet the requirements of a railway company exactly. The height of railway span wires is not more than 19 ft. above the ground. Below this point could be placed a cross-arm for railway feeders.

For the joint use of electric service and telephone companies the poles should be somewhat higher, say, 40 ft. Beginning at the top of the pole, the cross-arms should be, in turn, for the power-transmission lines, the arc-light lines, the telephone wires and cables, and the distributing circuits of the lighting company. The high-tension lines, which require infrequent visits and which are most dangerous, are placed nearest the top of the poles. They are usually installed with every precaution for reliability and safety, and rarely break.

Four arguments in favor of joint-pole lines were enumerated by Mr. Rau. These are, first, saving in initial cost of construction; second, saving in cost of maintenance; third, avoiding ill-will of the public, and, fourth, improving the appearance of the street.

To arrange an equitable basis for the installation and maintenance of joint-pole lines between the different companies de-

pends materially on local conditions. In some cases each of two companies might bear 50 per cent of the expense of installation, the maintenance to be at the expense of the individual company so far as attachments are concerned. Renewals of poles might be made by the company best equipped for doing the work in each particular case, the other company being billed for one-half the cost. This plan, however, would not be equitable on main pole lines or where the poles are not used to an equal extent by the different companies. A contract that will be fair to all interests can be drawn, however. Mr. Rau has given considerable attention to the subject and has been successful in bringing about a number of important pole-line combinations, avoiding the introduction of ordinances compelling underground construction.

Influence of Glare on Effective Illumination.

At a meeting of the Car Lighting Club in Chicago, March 15, this club being a subsidiary organization of the Association of Railway Electrical Engineers, some discussion was given to the subject of the effect of lamps within the field of vision and the reduction in the effective illumination which results.

Mr. Arthur J. Sweet, of Newark, Ohio, spoke of the well-known experiments which he carried out demonstrating that with a certain given light source the ability to see is not reduced when the source is more than 25 deg. from the direct line of vision. He also made an interesting statement in connection with the effect of diffusing globes in reducing the glare. He said that the results obtained by him, as well as by several other recent investigators of the subject, indicated very strongly that with a source of light giving the same candle-power in the eye of the observer in each case it makes no difference whether the light comes from a large opal diffusing globe in which almost perfect diffusion is obtained, or from a bare unshaded lamp. This is on the assumption that the candle-power entering the eye is the same in both cases. However, he said that even though there might be no measurable difference in the effect on the eye the diffusing globe was the most comfortable to face.

Mr. J. R. Cravath, following Mr. Sweet, emphasized the fact that while the measurable difference between the effects of the bare lamp and the lamp in its diffusing globe might be nothing, the comfort of the eye was considerably more with the diffusing globes. He then pointed out how in practical car lighting the effect of glare can be much reduced. Take, for example, a day car in which a row of lamps is placed over the seats along each side. If these lamps are bare and unshaded a considerable candle-power from each lamp enters the eye of any passenger looking the length of the car. By putting reflectors of diffusing glass over each lamp the candle-power in the direction of the passengers' eyes is much reduced, while the candle-power in downward directions is much increased. Thus not only is the glare in the passengers' eyes much reduced, but the intensity on a passenger's reading page is increased. The effect of the proper glassware over the lamps, therefore, is twofold, both effects being beneficial.

Transmission and Distribution Systems in Chicago.

The chief worriment of the officers of the Commonwealth Edison Branch of the National Electric Light Association in Chicago is caused by the difficulty of finding a suitable hall large enough to accommodate all the members who desire to attend the meetings. The membership of the branch is now 841, which is an increase of 73 per cent over the corresponding figure on Nov. 1, 1910, when the present officers were elected. At the meeting held on the evening of March 2 in Recital Hall, Auditorium Building, there was an attendance of 410, and it was announced that the next meeting would be held in Handel Hall, Randolph Street and Wabash Avenue, on April 4.

There were two papers read at the meeting of March 2, and the first speaker was Mr. Paul F. Williams, assistant general inspector of the Commonwealth Edison Company, whose subject was "The 60-Cycle Distribution System." Mr. Williams illustrated his paper with lantern-slide maps and diagrams showing the locations and characteristics of the company's 60-cycle circuits. It was shown that the nature of the territory served naturally modifies the characteristics of the service. A new substation is to be erected on Whipple Street near the new Northwest generating station at the intersection of North California Avenue and the North Branch of the Chicago River. There are sixty-five four-wire distributing circuits in the 60-cycle system. The maximum load carried on these circuits last year was 28,555 kw. The number of transformers connected to the 60-cycle system is 9565, with a total rating of 76,500 kw. The losses on the 60-cycle system last year amounted to 23.5 per cent, including losses in transformers, measuring instruments, etc.

The hardest work of the distributing engineer is to develop new territory, giving satisfactory service without undue expense to the company. All customers' complaints are answered by a personal call made at the time when the customer's consumption is at the maximum. Nearly all feeders in the 60-cycle system are now underground, and Mr. Williams gave several interesting diagrams illustrating the emergency switching equipment. The rather elaborate routine of making extensions was described. In many cases joint pole lines are used by the Commonwealth Edison Company and the Chicago Telephone Company, and where extensions are planned the preparations, involving the surveys, estimates, planning and correspondence between the two companies, take some time. If the extension costs less than $200 it is carried out under what is known as a "petty line order," but if the expense involved is over that amount it is necessary to obtain a "work order" with a number of additional signatures.

Mr. M. R. Rich, of the engineering department, read the second paper of the evening, taking as his subject "The Transmission System and Low-Tension Distribution." This paper was also illustrated by lantern-slide diagrams. Mr. Rich gave considerable attention to the method of making and preserving records of operating circuits. He described briefly the overhead distribution maps, the "location book" of the low-tension district, the cable records and the conduit and manhole records. In carrying on the business of a large system like that in Chicago the existence of carefully kept records of this sort is an imperative necessity.

Mr. Rich devoted some attention to the very heavy "downtown" low-tension direct-current load, and mentioned the interesting fact that several 1,500,000-circ. mil cables are sometimes needed in the case of a single customer. The kw-hour consumption in the central low-tension direct-current district in Chicago increased 18 per cent in 1910 compared with 1909. The total loss in this low-tension distribution is about 13 per cent, or about as much as is lost by conversion in substations.

Considering the 60-cycle, 12,000-volt transmission system, Mr. Rich remarked that electrical transmission of this description is comparatively recent in the history of the company's operations. The 60-cycle, 12,000-volt energy is produced by two turbo-generators at the Quarry Street station. (See the *Electrical World*, Jan. 5, 1911, page 35.) A map was exhibited showing the extent of this system. This system is connected to the hydroelectric plant of the Economy Light & Power Company on the Desplaines River at Joliet, Ill., some thirty-three miles from Chicago. The Joliet plant in turn is or soon will be connected to the widely extended system of the Illinois Valley Gas & Electric Company, so that it is computed that the connections of this system of transmission will be about 200 miles long within a few months.

The 25-cycle, 20,000-volt transmission system was also described briefly and the speaker exhibited curves showing the increase in the amount of copper installed for the low-tension, 25-cycle and 60-cycle systems. These curves show that the amount of 25-cycle copper is increasing at the greatest ratio. Another interesting fact mentioned by Mr. Rich is that 2,640,000 duct.-ft. of conduit were installed in the last year. This

large amount of new work was due to the building of the Northwest generating station and also to the tearing up of "downtown" streets incident to street-railway rehabilitation. It was also mentioned that the new railway substation in Edgewater, on the North Side, and, in fact, most of the North Side substations, will be connected with the new Northwest station when that is in operation the latter part of this year. Tie lines will connect the Northwest and Fisk Street stations.

There was no discussion except that Mr. George Harvey Jones was called upon as the first chairman of the branch, and spoke briefly. Resolutions extending the sympathy of the branch to the relatives of Mr. E. R. Stuart, of the contract department, who died recently, were adopted.

The latter part of the evening was given over to a very enjoyable entertainment, including music by an orchestra of twenty-seven pieces led by Mr. Harold Wright and Mr. C. H. Bucher. This was followed by a minstrel show, at which Mr. H. A. Seymour was interlocutor and Messrs. H. P. Smith, W. H. Childs, M. F. McGovern and T. J. O'Brien were blackface endmen in costume. The music was well rendered and the minstrel show was cleverly executed with snap and ginger. Every man who took part in this creditable performance is an employee of the company.

Minnesota Electrical Association at St. Paul.

The fourth annual convention of the Minnesota Electrical Association opened in the roof-garden sun-parlor of the Hotel St. Paul, St. Paul, Tuesday morning, March 14, with nearly 100 present. The membership of the association has now reached 125, twenty-five having been added during the last year. Following the report of Mr. T. C. Gordon, secretary of the association, and those of various committees, President R. W. Clark, of Minneapolis, delivered his official address, reviewing the progress of the central-station industry during the last twelve months. Mr. Clark mentioned the beneficial results of the new high-efficiency incandescent and arc lamps and the introduction of energy-consuming devices for increasing the day load. He paid tribute to the broad-minded, aggressive men in the electrical industry, commended the commercial and publicity campaigns that have been inaugurated and congratulated electrical manufacturers, supply dealers and lighting companies on the co-operation with which these three interests have worked to extend the use of electricity and electrical devices. Mr. Clark also mentioned the improved attitude toward electricity supply companies, which grows as the conveniences of electricity are more and more appreciated, and he referred to the teaching of elementary electrical subjects in the public schools. Well-organized commercial departments, said the president, are now considered a necessity by every progressive company. Taking up certain live central-station subjects in order, Mr. Clark discussed ornamental street lighting, the use of signs and special lighting, post lighting in residence sections, ice-making auxiliaries for central stations in the Northwest, electric vehicles and trucks, gasoline competition and commission regulation of public utilities. The president urged against local or city public-service commissions, declaring that a regulation policy if installed should be state-wide in extent, and administered by men of the most able character whose decisions would be based on the best engineering data. Commission laws are now in force in twenty-two states, said Mr. Clark, Kansas being the latest to adopt regulatory measures. Mr. Clark also referred to plans under way for holding an electrical educational exhibit at the next Minnesota State Fair.

Resolutions of respect were passed by the association in connection with the death of Mr. C. A. Yergen, of Owatonna, Minn., formerly an active worker in the organization, who was killed several months ago in the discharge of his duties.

Mr. Ludwig Kemper, of Albert Lea, Minn., opened the regular program with a paper on "Curb Lighting." After tracing the great growth of tungsten-post decorative illumination since the first system was installed in St. Paul, only a few years ago, Mr. Kemper quoted a tabulation of facts and figures of various such installations from the *Electrical World* of Sept. 15, 1910. These data showed the range of costs of installation and operation per front foot of street curb, income to company, etc. The average load-factor of curb-lighting systems, said Mr. Kemper, is 30 per cent, ranging from 22.5 per cent for dusk-to-midnight to 45 per cent for all-night lighting. The average income is about 5 cents per kw-hour. Curb illumination, properly treated as decorative lighting, he insisted, stimulates the use of signs and show-window illumination. Mr. Kemper discouraged, however, the use of any type of globe for post lamps which, even though increasing the effectiveness of street-surface illumination two or three times, presents complex surfaces to collect dust, or which requires the cleaning of more than one piece of glassware. Curb lighting, he reminded the association, is first of all decorative in purpose. The globes themselves should present an attractive and brilliant appearance, and if too high an intensity is produced in the downward direction neighboring show windows may receive such effective illumination as to eliminate the need and use of their own lighting. The speaker offered suggestions on the best plans of introducing such curb lighting into new towns and cities, advising that local civic or business organizations be first interested, illustrations of other installations exhibited and perhaps a sample block equipped. All individual contracts with merchants should preferably be made through the civic or business men's organization, to avoid trouble for the electric company. Such installations may be financed by the city, the merchants or the company, in the last case the company adding the capital charges to cover this investment to its rates for the service. Mr. Kemper advised keeping such installations within the financial capacity of the community, but assured his audience that curb lighting is an excellent and profitable load for the central-station company and one that is without gasoline or other competition, even in Mr. Kemper's own city of Albert Lea, where 30,000 gasoline-lighting outfits are made annually. Mr. Henry Schroeder, of Harrison, N. J., said that the General Electric Company is completing a collection of lantern slides and data on curb-lighting installations, copies of which it will be pleased to loan to central-station companies for furthering interest in special street lighting. Mr. Schroeder mentioned this in line with the suggestion of Mr. Kemper that the association should make such a collection. Mr. J. B. Crane, of Duluth, described the tungsten curb lighting in that city, and explained the method by which a committee of citizens there carried through the entire plans, installed the equipment and contracted with the lighting company for service. Mr. Crane also mentioned the peculiar coincidence that a number of the multiple tungsten lamps used on the Duluth posts had been found broken on certain mornings, while on other days no breakages occurred. The cause of this acute trouble was afterward traced to a flat-wheeled owl car operated during the early-morning hours. Mr. R. W. Clark, of Minneapolis, spoke of the staggered spacing of posts as limiting the intensity at street intersections where most illumination is needed.

At the afternoon session of Tuesday Mr. H. G. Winsor, of the Minneapolis General Electric Company, read a paper on "Safety in Line Construction," specifying the construction used by the Minneapolis company, and pointing out features of inspection, arrangement of equipment on poles, and grounding of secondaries which conduce to the safety of the public. An abstract of this paper will be presented in the *Electrical World*.

"Show-Case Lighting, Display-Window Lighting, Outline Lighting and Sign Lighting" were the subjects discussed by Mr. T. R. Wilwerschied, of St. Paul, who sought to remind electrical solicitors of the uncultivated fields in which they may still find rich central-station business. This paper and the discussion it provoked will be abstracted in a future issue.

Mr. F. R. Cutcheon, of the St. Paul Gas Light Company, spoke next on the testing of watt-hour meters. In general, he said, customers' tests have superseded shop tests of watt-hour meters, the meters now being tested after being installed and connected up. Routine shop tests are carried out, however, in the case of new meters or those long out of service, or when

it is desired to obtain certain data about the instrument. Mr. Cutcheon spoke of testing a number of meters simultaneously, their fields being connected in series and their shunts in parallel. He also described the use of transformers for testing large alternating-current meters and storage batteries for large direct-current meters. In the use of the many light-weight test resistances offered on the market, he said, it is a choice between portability and durability. The lighter apparatus is sure to get hotter and to be more rapidly destroyed, but a heavier outfit may require a second man to carry it, the latter's wages exceeding the cost of burning up a number of resistances during the year. In St. Paul polyphase meters are being used on the three-phase lines of Mr. Cutcheon's company, avoiding errors due to unbalancing of the phases. The speaker also referred to the use of clock meters to determine the diversity factor of a customer's installation. On account of the thefts of energy which are accomplished by opening the neutral fuse of a three-wire system, de-energizing the shunt, Mr. Cutcheon suggested the use of some device in circuit with the shunt connection, such as an electrolytic or thermal cell, to show whether the shunt had been disconnected for any period during the month. In the case of 72 per cent of the direct-current meters tested on the St. Paul company's lines the meters were found running slow, favoring the customers, while 86 per cent of the meters were within 5 per cent of accuracy.

Mr. J. T. Crane, of Duluth, told of the requirement of the New York Public Service Commissions regarding meter testing, and Mr. E. T. Street, of St. Paul, spoke of the use of a 500-amp, 5-volt direct-current generator by the Northern Heating & Electric Company for testing large direct-current meters. Mr. M. B. Beattie, of Fort Wayne, Ind., suggested that manufacturers will be pleased to furnish meter experts in cases where meter testing is the subject of controversy between an electric company and the local authorities or others.

Mr. E. T. Street, new-business manager of the Northern Heating & Electric Company, opened Wednesday morning's session with a paper on the subject of "Day Loads for the Central Station." After proposing a rate schedule based on maximum demand added to a given charge per kw-hour consumed, Mr. Street mentioned the subjects of water pumping, mechanical refrigeration, wood-working establishments, grain elevators, laundries and electric heating appliances as good day loads, several of which have the advantage of requiring most energy during the summer months. Strange as it may seem, said Mr. Street, mechanical refrigeration in the cold climate of St. Paul is cheaper than ice refrigeration, even though the customer stores his own ice and is near the source of natural supply. A number of refrigerating plants are already installed in St. Paul and more are being put in each year.

Mr. J. B. Crane, of Duluth, declared that a rate of the kind described, though satisfactory for average power-factor customers, may become unjust for those installations having extreme high or low power-factors. Mr. Ludwig Kemper, of Albert Lea, said that in comparing mechanical refrigeration with ice cooling at least 40 kw-hours per ton of refrigeration must be allowed, besides considering the cost of water, repairs, ammonia charges, interest and depreciation. Mr. J. D. A. Cross, of Chicago, recounted interesting results of electric iron campaigns in establishing partial and, later, full-day service.

The paper on "Residence Lighting," by Mr. C. E. Van Bergen, of the Duluth Edison Electric Company, was read by Mr. C. W. Higgins, of Duluth. Mr. Van Bergen's paper presented some interesting figures on electric service in Duluth and referred to the profitable development which residence lighting may obtain when properly viewed. The mistakes often made in residence illumination were also pointed out, and central-station companies were urged to keep the subject of proper lighting before architects, builders and contractors to make household electric service of permanent satisfaction.

Mr. H. J. Gille, of Minneapolis, declared that residence lighting presents greater possibilities than any other field now before the central station. Hardly 12 per cent of the total residences of the country use electric light, he said. It has been shown that while the revenues per kilowatt of customer's demand are low for residences, this business still yields at least the average revenue per kilowatt of station demand. Only about 35 per cent of the residence load overlaps with the afternoon peak. Mr. Gille advised the appropriation of association funds to establish an electrical exhibit at the state fair. Mr. A. H. Dickerson, of Windom, also referred to the importance of residence business in the smaller towns.

"Incandescent-Lamp Improvements" was the subject of a paper read by Mr. Henry Schroeder, of Harrison, N. J. After tracing the history of filament lamps up through the carbon, graphitized-filament, tantalum and tungsten types, Mr. Schroeder presented some surprising figures on the number of standard styles and sizes of incandescent lamps in regular use, declaring that the figure exceeds 100,000 different kinds of lamps. Mr. H. G. Gille, of Minneapolis, referred to the Twin City region as the original "stamping ground" of the tungsten lamp, and asked questions regarding expected future efficiencies, costs, etc. Mr. Schroeder said that the drawn-wire type lamp will shortly be ready for marketing, after preliminary experience in car-lighting work, the success of which has surprised even manufacturers. Manufacture in large quantities will tend to lower the price of tungsten lamps, said the speaker, while the cheaper processes of making the wire-drawn lamp, the filament strength of which is increased in strength about four times, also contribute to this cheapening. Mr. Gille and Mr. Dickerson advocated the use of all-frosted tungsten lamps for residence work.

On Thursday morning a paper by Mr. A. W. Wagner, manager of the Huron Light & Power Company, Huron, S. D., recounting the experience of his company with its 400-hp gas-producer plant, was read by Mr. E. T. Street in Mr. Wagner's absence. The paper contained many valuable observations on the subject of producer operation for central stations, and an abstract of it will be presented in a later issue of the *Electrical World*.

Mr. R. L. Daniel, of the Minneapolis Underwriters' Bureau, read a paper on the subject of insurance as affected by electrical installations, both in central-station properties and in premises wired for electricity. Mr. Daniel discussed the base rate for electric plant risks, and enumerated the conditions which affect this charge by adding penalties and credits. The speaker urged better protection where high-tension wires cross other lines or highways. He declared that there are few instances where the replacement of a gasoline-lighting outfit by electric service, or a gasoline engine by an electric motor, will not make a reduction in the fire hazard and in the cost of insurance.

Mr. Eugene Holcomb, general manager of the Northern Heating & Electric Company, St. Paul, exhibited some useful form blanks for keeping the engine and boiler-room records of plants up to 250-kw capacity. Mr. Holcomb's paper referred less to the form than to the items to be recorded on these record sheets, and enumerated the principal data that should be given, including: Date, coal on hand, coal used, feed water used, evaporation per pound of coal, time of boiler and engine operation, cylinder oil used, labor on repairs, labor on operating, total output, and pounds of coal per kw-hour.

A paper on "Gasoline Competition" by Messrs. Ward Harrison and H. H. Magdsick, of Cleveland, Ohio, was read by the former. The principal kinds of gasoline-lighting plants were clearly described, and a comprehensive summary was presented of the shortcomings and dangers of gasoline-lighting systems. An abstract of this material will be given later in these columns. Mr. R. W. Clark and Mr. E. Holcomb discussed means of combating gasoline competition.

Mr. Robert Ferris, of Yankton, S. D., explained the elements of his system of uniform accounting for central-station companies having receipts of from $10,000 to $50,000 a year. Mr. Ferris proposed to arrange the books under the heads of four accounts, liabilities, assets, receipts and expenses, and to any small central station desiring them he offered to send copies of his accounting system on request.

Messrs. E. Holcomb, H. J. Gille and R. Brown, appointed by President Clark to nominate officers for the succeeding year, reported the following, who were unanimously elected by the association: President, Mr. Ludwig Kemper, Albert Lea; first vice-president, Mr. C. E. Van Bergen, Duluth; second vice-president, Mr. E. A. Aspnes, Montevideo; secretary-treasurer, Mr. E. T. Street, St. Paul.

A discussion and demonstration of the elementary theory of the rotating-field alternating-current motor, which had been prepared for presentation before the convention by Prof. George D. Shepardson, of the University of Minnesota, was given by his associate, Professor Ryan, of the university, on account of Professor Shepardson's enforced absence in the East owing to the serious illness of his sister.

On Wednesday afternoon the members of the convention made up an inspection party through the power plants of the Northern Electric & Heating Company and the St. Paul Gas Light Company and were also conducted on a twenty-six-block tour of the extensive sand-rock tunnels of the latter company underlying the business district of St. Paul. In the evening a Dutch lunch, smoker and vaudeville entertainment was tendered the delegates at the Nordin Club. Mr. H. J. Gille was toastmaster, and called upon President R. W. Clark, Messrs. J. Barnard, R. Smith, J. B. Crane, J. D. Cross, Ludwig Kemper and others for speeches. Mr. A. A. Anderson was in charge of arrangements for the affair.

Electrification of Steam Railroads.

At a meeting of the New York Railroad Club held in the Engineering Societies Building on March 17 the general subject of the electrification of steam-railway systems was discussed. Mr. W. J. Harahan, assistant to the president of the Erie Railroad, as chairman of the electrical committee, explained that this committee had considered it unnecessary to submit a formal report during the present year in view of the fact that the report submitted one year ago covered conditions as they now exist, almost no changes having been made in systems or methods of operation during the past few months. He stated, however, that experience had shown that all of the systems have points of merit. Each one seems particularly well adapted for certain service requirements. Although no formal papers were presented, Mr. Harahan read a communication from Mr. J. A. McCrea, general superintendent of the Long Island Railroad, giving an outline of the experience of this railway with electrical operation. Electricity has been substituted for steam on this system gradually during the past five years. Mr. McCrea stated that if steam were now to be substituted for electricity enormous difficulties would be encountered on account of the changes and improvements that electrical operation has allowed to be introduced. A considerable number of the changes incident to electrical operation were attributed by him to the multiple-unit system. By means of this system the trains can be run into the terminal station and made ready for the return journey with the minimum of delay. During rush hours a train is sent out on the return trip with only the delay attributable to the change in passengers. Moreover, the use of the higher platform has resulted in minimizing the time of emptying the trains and reloading. Therefore, the final result has been that a much smaller amount of terminal trackage is required for electrical operation than would be used with steam locomotives. Electrical equipment has proved thoroughly reliable, and trains are operated rigidly upon schedule time.

Prof. George F. Swain, of the department of civil engineering of Harvard University, gave an exceptionally clear explanation of the action of the committee which submitted a report to the Massachusetts Legislature relative to compulsory electrification of steam roads in Boston. He stated that the conditions around Boston are very different from those around New York. For example, complete electrification would involve twenty-one roads and branches around Boston, while in New York only three are involved. Thus the total cost would be enormously greater for Boston than for New York. Moreover, the need for electrification is much less in Boston, there being at present no tunnel problem to complicate matters. It was found that in order to equip electrically merely the most important of the railroads in metropolitan Boston would cost about $40,000,000 for the passenger traffic alone. An expenditure of this amount would not be justified by the returns received from it by the railroads, on account of the fact that the cost for maintaining the steam equipment for operation over the roads would not be decreased, while the electrical operation would represent an added cost over and above the interest on the money invested. If one were permitted to assume the Legislature to have the power to compel railroads to invest money in electrical equipment, he must admit that the roads should be permitted to increase the traffic rates, if such an increase were found necessary in order to obtain a proper return on the money invested. In the case just mentioned the only improvement in service would be to passenger traffic, and hence the only increase in rates should apply to passenger service. In view of the fact that the steam roads are paralleled by electric roads it is highly probable that an increase in rates would not result in an increase in revenue on account of the deflection of travel to the competing electric roads. The committee held, first, that the investment of the money required was not justified; second, that if such investment were made the roads would be justified in increasing the rates, and even with an increase in rates the return on the investment would be inadequate. Moreover, it expressed the decided opinion that electrification at the present time should be looked upon as a luxury and not a necessity, and that it was improper for the Legislature to dictate to the railway corporations what type of motive power should be employed, unless the employment of such equipment would result in greatly improved service of much benefit to the community. It is proper for the government to regulate the issuance of securities by public-service corporations, to determine what equipment should be employed for insuring the safety of passengers and to dictate concerning the rates asked for service, but it is improper for the government to force corporations to supply what may properly be looked upon at the present time as a luxury. Professor Swain remarked that the railroad corporations around Boston will settle the problem eventually to the satisfaction of all parties concerned, which fact is being shown by the recent petition of the New York, New Haven & Hartford Railroad for permission to construct a tunnel under Boston, in which event electrical operation would be insured.

Mr. H. Gilliam, of the New York, New Haven & Hartford Railroad, outlined the results now being obtained by this railroad with its single-phase equipment. He called attention to the frequently neglected fact that during quite a considerable portion of the time the electric trains coast, even along a level stretch. For example, the power is applied to the average train of the New York, New Haven & Hartford Company's system for only twelve of the thirty-three and one-half miles of travel. The distance is traversed in fifty minutes, during only seventeen of which is energy used. These facts have considerable bearing on the estimate of the cost of operating with electricity as compared with steam. When steam locomotives are used coal is consumed continuously, even when a locomotive is coasting down hill or on the level.

Mr. William McClellan discussed quite fully the relative merits of steam and electric operation, and mentioned particularly the fact admitted at present that electric equipment is much more reliable than steam. When the substitution of electricity for steam on railroads was first adopted many railroad men questioned the advisability of depending upon a single stationary source of energy, rather than a large number of portable power houses, because the crippling of a single locomotive would not interfere seriously with the operation, while the crippling of a single generating station would bring the whole system to a standstill. However, the electric generating equipments have proved absolutely reliable in service. Mr. McClellan called attention also to one of the most en-

couraging features of electric railway operation, namely, the fact that the most ardent advocates of each system are those most familiar with the particular system advocated. He claimed that the time had arrived for looking forward definitely to the selection of a single system for standardization in order that rolling stock may be properly interchanged between interconnected railroads.

Mr. Frank J. Sprague remarked that at the present time the contention is not one between different systems, but rather the broader fight between electricity and steam. All of the electric systems advocated are good, and it cannot be stated definitely that any one system is better than another for general adoption. Each system possesses peculiar merits for certain local conditions, and the different systems must be considered competitive in order that the proper choice can be made when selecting the system best suited for the problem in hand. What is most needed at the present time is active and sincere co-operation between the engineers and the railroads. It can safely be stated that the time has not yet arrived for the general electrification of steam railroads. The improvements which can easily be introduced into the trunk line railroads, such as the elimination of grades, the lessening of curves, increasing of trackage, etc., have not yet been exhausted.

Mr. W. S. Murray, electrical engineer for the New York, New Haven & Hartford Railroad, stated his definite conviction that the single-phase system has been proved by actual experience to be thoroughly well suited for trunk-line operation. It possesses just those features which in the development of electrical engineering have always served to distinguish long-distance from local transmission of energy. An exactly similar difference exists between trunk-line and terminal electrification. That the single-phase system has proved satisfactory to the New York, New Haven & Hartford Railroad is conclusively proved by the fact that arrangements are now being completed for increasing the electrified track mileage from 100 miles to 373 miles. He stated that the reliability has now reached such a high degree that on an average a length equivalent to eleven times the distance from New York to San Francisco and return is traveled by each locomotive for each minute of train delay.

Mr. W. B. Potter described briefly the self-propelled type of railway car, which consists of a gasoline engine driving a variable-voltage generator, which supplies energy to standard 600-volt railway motors. On account of the reduction in voltage of the generator at starting, with the accompanying elimination of the losses in the starting rheostats, a 200-hp gasoline engine is capable of producing that amount of torque which would necessitate a 1000-hp engine if the generator were of the constant-voltage type. A self-propelled car of this type carries fuel sufficient for 200 miles, and operates with the same independence of connection to the power house as does the steam locomotive, but with the economy and flexibility of control of the electrical equipment. Moreover, for branch service the self-propelled car equipment is cheaper, both in first cost and operation, than is an equipment run by a steam locomotive.

Mr. A. H. Armstrong reported the results of some observations made by him upon steam locomotives under service conditions. A certain small steam locomotive was found to consume 40 lb. of steam per hp-hour delivered at the rim of the wheels, the consumption of fuel being 8 lb. of lignite coal per hp-hour. The values just given relate to the steam locomotive during a haulage period. However, during the standby period this locomotive consumed continuously 500 lb. of coal per hour, the final result being that the total consumption of coal throughout each day reached 12 lb. per effective hp-hour utilized. He stated that the steam locomotive carries sufficient coal for a journey of about 150 miles, at the end of which it must be replaced by a second locomotive if the journey is to be continued at the maximum speed. An electric locomotive, on the other hand, can travel at least 1000 miles before it need be replaced. In a haul of 1000 miles, on account of the unavoidable delays as compared with the electric locomotive, the time consumed by the steam locomotive would be thirty-six hours longer than with the electric locomotive.

Investigation Into Value of Telephone Properties in Seattle, Wash.

Messrs. C. H. Judson and Frank B. Hall have made a report to Mr. A. L. Valentine, superintendent of public utilities of Seattle, Wash., in reference to the value of the properties and cost of service in that city of the Independent Telephone Company and the Pacific Telephone & Telegraph Company. The report is the result of an investigation made for the purpose of ascertaining the probable cost to the companies of the existing plants; the probable present value after allowance for depreciation; the actual cost of operation, including all reserves and charges; the approximate dividend earned on the investment in the various classes of telephones, and the efficiency and adequacy of the service.

Although a complete detailed inventory of the entire properties was not made, use was made of a large amount of information obtained from the companies and from observation of their operations, as well as of data obtained from other companies and from the knowledge of the engineers of operating costs in detail. The area of the city is eighty-five square miles and the line property of the companies consists of over 500 miles of pole lines, 228 miles of underground conduits, about 85,000 miles of wire in cables and 8900 miles of open wire on poles. In the valuation of the property of the Independent Telephone Company prices on all materials used were procured from manufacturers, agents and dealers f.o.b. Seattle. To present prices and the cost of labor allowances were made of 10 per cent for engineering and superintendence, 10 per cent for general expenses and 6 per cent for interest. A unit schedule of cost was prepared covering all parts of the plant except central-office equipment, real estate and buildings, and the valuation was figured from the itemized inventory.

The cost of the plant of the Independent Telephone Company, as determined by partial inventory and from company records, was placed at $2,091,672, and the depreciation at $607,559, leaving a depreciated value of $1,484,113. A total allowance of $175,000 was made for intangible assets, as follows: Discount on bonds, as per the company's records, $100,000; working capital, estimated, $50,000; cost of obtaining stations during the early construction period, $25,000.

The total amount expended on the construction of the plant of the Independent Telephone Company from Jan. 26, 1901, to Sept. 1, 1910, was $2,056,984. To this amount there should be added the first cost of real estate, buildings, furniture and fixtures, and supplies on hand, a total of $192,048, or a final total of $2,249,032. Certain items, including discount on bonds, are also specified, with the statement that the engineer of the Railroad Commission in his report on the property held that they did not properly enter into the first cost of the plant and should not be so considered. If these are deducted the cost would be $2,249,032, less $282,428, or $1,966,604. If it is desired to deduct additional expenditures of $25,959 for the replacement of conduits and $60,154 for the cost of moving poles on account of regrades, the first cost would be reduced still further. The total determined in this way would not include, however, any charge for interest during construction. The total earnings of the Independent company to Aug. 1, 1910, were $2,130,902, and total expenses $1,721,115, leaving a balance of $409,787. After provision for other charges and for dividends the surplus as of Aug. 1, 1910, was $73,489.

The portion of the report which relates to the Independent Telephone Company goes into details as to costs of various classes of service and the expenditures which enter into such costs. The report in reference to the Pacific Telephone & Telegraph Company, however, is not intended to cover actual service costs.

The population of Seattle in 1909 is stated as follows: School census, 39,866; names in directory, 123,750; estimated population, 252,000. The total number of telephones of the Independent Telephone Company was 18,027, and the number of main stations 12,414. The gross expenses were $276,471, or an average of $15.57 per telephone and $22.36 per main station.

A report furnished by the Pacific Telephone & Telegraph Company on May 12, 1909, showing the business of the Seattle exchange, indicated a total of 23,914 telephones and 18,413 main stations. The gross expenses were $589,014, or $24.63 per telephone and $31.99 per main station. The expenses include maintenance, operation, general expenses, insurance and taxes.

The cost of the Seattle plant property of the Pacific company was figured at $2,981,180, and the depreciation at $758,635, leaving a depreciated value for the tangible property of $2,222,545. Intangible assets aggregated $100,000, of which $75,000 was an estimate of the working capital and $25,000 the estimated cost of obtaining stations during the early construction period.

Rate Question as Affected by Competing Telephone Companies in Chicago.

An interesting resolution was introduced into the Chicago City Council at its meeting of March 6 by Alderman W. J. Pringle, chairman of the committee on gas, oil and electric light, which has in charge the matter of revising telephone rates. This resolution, after referring in general terms to the consolidation of public-service corporations, recites that the Illinois Tunnel Company has made a large investment in land, buildings, conduits and cables and is continuing to make such investment by the rapid enlargement of its plant. However, there is already a telephone utility in the City of Chicago—the Chicago Telephone Company—with a plant extending over all portions of the city and well developed in the territory now being occupied by the Illinois Tunnel Company. Thus the facilities of the Chicago Telephone Company, which are now ample, or can be made ample, will be duplicated.

After setting forth this condition the resolution makes the following declaration: "It is the sense of this Council that in all consolidations and combinations of public-service corporations in this city the construction account of the purchasing company shall be charged only with the cost of the property actually used by and useful to the purchasing company in the furnishing of the service involved, and in any negotiations hereafter looking to the determination of a reasonable rate or schedule of rates for such service the valuation to serve as the basis of such rate determination shall embrace only such property as has been constructed at the actual cost price and as is not an unnecessary duplication of the property of the purchasing utility, including an allowance for engineering, supervision and interest, taxes and insurance during the construction, plus 8 per cent since the date of construction, less profits which have been taken out of the property, not to exceed 8 per cent."

The Council appeared to be doubtful about the exact effect of adopting the resolution, and it was referred back to Alderman Pringle's committee. The latter is reported to have said that no one doubts that the Illinois Tunnel Company ultimately will be absorbed by the larger company. In that contingency the valuation of the older company will be much larger, and it is desirable that the rights of the public as to rates based on valuation of property be protected.

Public Utilities Before California Legislature.

A new draft of the constitutional amendment putting the control of all public utilities in the hands of a State commission in California has been made and will become a committee substitute in both houses of the California Legislature for the measures now pending. As a result, all the duties of a public-utilities commission will be imposed on the Railroad Commission, whose membership is increased from three to five members, the present elected members to continue in office. The other two members will be appointed by the Governor. The term of office is made six years. The Legislature may remove one or more members by a two-thirds vote for dereliction of duty, corruption or incompetency. The Railroad Commission receives power to establish all rates, a plenary power of investigation and power to require uniform accounting. A provision gives the City of Los Angeles the right to vote on what powers it will retain in preference to State control of its public utilities.

Hearing on Massachusetts Municipal-Ownership Bills.

A hearing was given at Boston on March 8 by the legislative committee on public lighting upon six bills now before the General Court in connection with municipal ownership of gas and electric lighting plants. Three of the bills (Senate 36, House 407 and House 942) are designed to modify the procedure in case a municipality desires to engage in the business of gas or electric lighting and their general intent is to make it much easier for municipal ownership to be undertaken than under the existing statutes. Three other bills (House 216, 1342 and 1447) are more radical in character, and besides cutting down the number of votes required to enable a municipality to engage in lighting supply they attack the compulsory purchase feature of the existing law, and, if passed, would permit cities and towns to assume the responsibilities of municipal ownership without anything like fair compensation to the established company or companies for the plant and business existing. Counsel present at the hearing included A. E. Pillsbury, Esq., and Frank E. Dunbar, Esq., for the Massachusetts Gas Companies, and Everett W. Burdett, Esq., for the Massachusetts Electric Lighting Association.

Mr. Pillsbury submitted a vigorous argument against municipal ownership, pointing out that it is inconceivable that any Massachusetts Legislature will ever repeal the compulsory purchase feature of the statutes controlling the entrance of cities and towns into the municipal lighting field. For twenty years the policy of the State has been to require municipalities to purchase the plants of existing companies before entering the lighting field. Mr. Pillsbury emphasized the small growth of municipal lighting in Massachusetts in the past twenty years by stating that out of 356 municipalities in the commonwealth only twenty-eight had established city or town plants since 1891. This means that the business of municipal lighting has not become popular and for the reason that it has never been genuinely successful. Not in any single instance has the price of gas been reduced or the service improved unless at the expense of the public treasury.

Closing, Mr. Pillsbury said that there is no evidence to-day that any municipality is getting cheaper or better electricity or gas than is sold by the private companies. The underlying principle is not appreciated by the public, but it is an unquestioned fact that much of the burden of municipal plant operation is being sustained by taxpayers of small means who are in many cases not consumers of the service. This is a fact not realized by the man in the street, and such a condition is grossly unjust. At the bottom of the entire question lies the point that the government can never, or at least will never, do business to advantage in comparison with private enterprise, on the ground of financial comparison. Wherever governmental ownership and operation enter hours are voted down, wages are pushed up and places made for political reasons. Regarding the charge that gas and electric companies are to-day making extortionate profits, Mr. Pillsbury said that the public is perpetually confusing par value and market value. On the par value the rate of dividend may be high, but on the market value, which represents the total money put into the purchase of stock, the return runs between 4 per cent and 5.5 per cent. An inquiry addressed some time since to the Massachusetts Bureau of Statistics of Manufactures resulted in the information that a profit of at least 6 per cent was expected after an interest charge is made against the invested capital, which means a return of from 11 per cent to 12 per cent on the money in the business. The argument that gas and electric light companies are monopolies is ridiculous in view of the existence in many places of the most acute competition between gas and

electricity, and especially in view of the regulation of rates in the hands of the Gas & Electric Light Commission of the State. The restriction of price does away with the monopoly consideration. The hearing was continued to enable further arguments to be submitted.

Public-Service Commission Bills in Illinois.

In addition to the Rawleigh and Ettelson bills creating public-service commissions in Illinois and now pending in the Legislature of that State a third public-utility bill, which has the support of Governor Deneen and the State administration, has been introduced by Senator Chamberlin. This bill, like the Rawleigh bill, extends the powers of the Railroad and Warehouse Commission to embrace all public utilities.

Another hearing in relation to the Rawleigh bill was held at the capital on March 15. The proposed law seems to be favored generally by representatives of the public-service companies, while the Mayors and other officials of some of the smaller cities of the State are doubtful about it, as it curtails their powers. The Rawleigh bill does not affect Chicago. Mr. H. E. Chubbuck, of Peoria, vice-president executive of the Illinois Traction System; Mr. David Davis, manager of the United Gas & Electric Company, of Litchfield, and other representatives of electric service companies appeared at the hearing of March 15 to favor the general plan of the Rawleigh bill. It was announced that the next hearing would be held on March 22.

Proposed Ohio Public-Service Commission.

At a hearing of the Winters public utilities bill before the committee on codes of the Ohio House of Representatives last week representatives of the Joint Civic Committee of Cincinnati appeared and pointed out a number of weaknesses that, in the opinion of the members of the organization, should receive attention, and Mr. Albert Bettman, their spokesman, objected to the plan of fixing charges for service on the basis of capital stock, which in many cases, he said, is largely water, and argued that they should be fixed according to the true value of the property. If the commission is compelled to take into consideration the market value of the stocks of corporations it will be greatly handicapped, as it will have to fix charges that will cover dividends upon a large amount of water.

Another objection to the bill is the provision that corporations may issue bonds covering expenditures for the five years preceding. It is claimed that the bonds may thus be made to include wages paid out during those years, whereas wages are never included in the capital investment under ordinary conditions. Mr. Bettman stated that, in its present form, the bill does not apply to public lighting companies in their service to municipalities and that there is no authority to compel the extension of feed wires or gas mains. He believes that municipalities should have such authority, limited by evidence showing that such extensions would prevent the company from deriving a fair profit from the whole system, including the extensions.

Attorneys representing the Cincinnati Gas & Electric Company and the East Ohio Gas Company argued that the contracts for lighting should not be placed in the hands of a State commission, but should be left with the city councils, as such a provision would be unfair to the people which the companies serve. This argument was presented, not because the bill now provides for such a change, but for the reason that strong effort is being made to incorporate it in the proposed law.

Mr. Frank Woods, author of a similar bill before the Legislature last year, spoke in favor of this measure as being better than nothing, even if it does not contain all that could be desired. He said that with the multiplication of commissions their duties would soon so overlap as to become confusing and that one commission should have charge of all utilities.

Representative Calvey, of Cleveland, has presented a bill giving municipal councils the authority to fix rates for telephone service by amending the general code giving councils power to fix a maximum rate for electric light, gas and water. Neglect to furnish service at rates fixed by council will subject the corporations concerned to the danger of losing all charter rights. Mr. Calvey claims that this bill will not interfere with the Winters public utility bill, as a State commission under that bill can only act as a board of arbitration in the matter of rates and does not attempt to fix the prices for service.

While the Winters bill extends to all public utilities, with the exception of city street-railway lines, it provides for merging corporations only in the case of telephone companies. Judge Winters contends that this right can be extended to other utilities later on if it is found to work well with the telephone companies, and that if a mistake has been made then the privilege can be taken from these companies.

It is said that the corporations affected will make their contest against the Winters bill in the Senate. Many of the provisions of the bill are not satisfactory to them, although many of their number favor a law that they consider to be fair.

Massachusetts Legislative News.

The reports of various committees which are now being sent in to the two branches of the Legislature indicate little willingness at the present session to pass statutes inimical to the fair interests of the railway and lighting companies. The efforts of the Bagley interests to secure legislation respecting the price of gas in East Boston have met a severe setback in the adverse report of the committee on public lighting upon House Bill 499, which is an attempt to reduce the price of gas in the above community. A similar adverse report has been sent in upon House Bill 744, which attempts to reduce the price of gas in the City of Woburn, and both reports have been accepted. A resolve has been passed to a third reading in the Senate to provide for an investigation of the cost of supplying electricity to the State House building by the Boston Edison Company in place of the existing isolated plant. A number of bills tending to hamper the operation of street-railway companies have also been sent back to the House or Senate with adverse reports from the committee sessions.

Widespread interest has been aroused at Boston as a result of the statement of plans for the construction and electrification of a tunnel under Boston Harbor given out by Vice-president Byrnes of the New York, New Haven & Hartford Railroad Company at a recent hearing. Closely related to the New Haven tunnel project is the campaign which the promoters of the Boston & Eastern Electric Railroad Company are making to secure the passage of a bill requiring the Railroad Commission to issue the latter a certificate of exigency permitting the construction of a high-speed electric line between Boston and the North Shore. As a result of the latest proposals of Mr. Mellen and his associates regarding the purchase of the Boston, Revere Beach & Lynn Railroad and the tunnel construction under the harbor with electrification accompanying, the outlook for the success of the Boston & Eastern plan appears more and more doubtful. The willingness of the New Haven interests to undertake the handling of the North Shore suburban traffic, as well as the operation of through service, in large measure appears to determine whether or not the Boston & Eastern project will be permitted to become a reality. An incidental result of the publication of the New Haven tunnel project has been a subsidence of a considerable portion of the adverse criticism which was brought to bear upon a majority of the Board of Railroad Commissioners at the time the board refused to issue a certificate to the Boston & Eastern Company. An initial electrification of a part of the Boston

suburban service appears highly probable in the very near future.

The Ware Electric Company has petitioned the Gas and Electric Light Commission for authority to issue additional capital stock to the amount of $10,000 to meet the cost of improvements in the property. The Charlemont Electric Light & Power Company has also petitioned the board for authority to buy the property of Mr. G. H. Turner, its present controlling interest.

New York Commission News.

The Public Service Commission, Second District, has approved of an agreement whereby the Geneva-Seneca Electric Company and the Wayne County Gas & Electric Company consolidate into and form the Central New York Gas & Electric Company. The consolidated company is authorized to issue its common and preferred stock in accordance with the terms and provisions of the consolidation agreement—one share of preferred stock and two shares of common stock in exchange for each three shares of the present outstanding stock of the constituent companies. The new company is authorized to issue $150,000 of additional preferred stock, to be sold at par, to execute its mortgage to secure an issue of $2,000,000 in bonds, and to issue presently $650,000 5 per cent bonds, which shall be sold at not less than 85. The company is also authorized to issue a second mortgage to secure an issue of $150,000 6 per cent five-year notes, to be sold at par and for cash. The proceeds of the $950,000 bonds and stock to be issued are to be used for the purchase of the plant of J. Q. Howe's Sons at Phelps at a price not exceeding $15,000; for the construction of a transmission line from Geneva and Newark via Phelps and, for the construction of a substation at Phelps; for the retirement and cancellation of the existing outstanding bonds and mortgage debts, notes and unsecured indebtedness of the Geneva-Seneca Electric Company and the Wayne County Gas & Electric Company, and for the completion of the improvements to the plant of the consolidated company which have been authorized by the commission. The new company is in control and will operate a number of lighting companies in Wayne and Ontario Counties.

Massachusetts Commission News.

The Massachusetts Gas & Electric Light Commission has issued an order approving the issue by the Gardner Electric Light Company of 850 shares of preferred capital stock at $100 per share and of 200 shares of common stock at $150 per share. The proceeds of the issue are to be devoted to the cancellation of notes and bonds and to the payment of the cost of the extension of the distribution system of the company into Westminster, Hubbardston, Barre and Winchendon. The Colrain Electric Light & Power Company has petitioned the board for authority to consolidate with the Greenfield Electric Light & Power Company, on the basis of an exchange of stock share for share. The Shelburne Falls Electric Light & Power Company has also petitioned the board for the right to consolidate with the Greenfield company, upon a share for share basis. The Greenfield company has petitioned the board for the right to issue additional stock of the par value of $175,000. The proceeds of this issue are to be devoted to the purchase of the Colrain and Shelburne Falls companies and to meeting the cost of improvements that are soon to be undertaken in the company's system.

Governor Foss has appointed Mr. Walter Webster, of Boston, as expert investigator of the principal public-utility and administrative commissions of the State. A study will be made of the accounts and administration of the various boards, and a report submitted to the executive office upon the general conduct of their affairs.

Maryland Commission News.

The Maryland Public Service Commission last week granted permission to the Towson & Cockeysville Electric Railway Company for the construction of an electric road between the two towns named in its title, and work will begin on the new line within thirty days. The commission has authorized an issue of $100,000 capital stock, to be used in the purchase of the necessary rights of ways, constructing material and rolling stock, and for the actual work of building the road as far as Timonium. Most of this stock has already been subscribed for and options have been obtained on most of the properties over which the line will pass. The Towson & Cockeysville Electric Railway Company has declared its intention to apply to the commission for permission to increase its capital stock when the road has been extended to Timonium.

Without a single objection to the action the application of the reorganization committee of the Washington, Baltimore & Annapolis Electric Railway and Baltimore Terminal Company was approved last week by the commission. The sale of the road will proceed as under the terms of the United States District Court in the proceedings of the foreclosing of the mortgages at the Naval Academy Junction. It is expected that the Annapolis Short Line may make an effort to secure it at a reasonable figure.

Canadian Hydroelectric Commission News.

The Hydroelectric Commission is to call for tenders for material for from seven to eight miles of transmission line from a point on the Severn River to the towns of Midland and Penetanguishene, including the transformer station apparatus. The actual work of construction will be carried out by the commission under the direction of Chief Engineer P. W. Sothman, and it is hoped to supply these municipalities with energy by June 1.

The town of Midland some time ago decided to buy out the local plant, and a by-law will be submitted to the ratepayers giving authority to raise $16,500 for this purpose, and also to enable the town to enter into a contract with the Simcoe Power Company for a supply of energy from its development at the Big Chute Falls on the Severn River. The company already has a contract with the Hydroelectric Commission for 1500 hp on what are considered reasonable terms, and this power will be transmitted by the commission on the line to be constructed by it to the above towns, which will in turn distribute the energy through the municipalities.

On March 14 Niagara energy was turned on at Galt in the morning and at St. Mary's in the afternoon. Both tests were satisfactory in every way.

CURRENT NEWS AND NOTES.

German Society of Consulting Electrical Engineers.—Dr. R. Blochmann, of Kiel, is president of the Verein Beratender Ingenieure für Elektrotechnik, having succeeded Dr. E. Mullendorff, of Berlin, on Jan. 1. The present headquarters of the society is at 24 Lornsen-strasse, Kiel.

Institute of Operating Engineers.—A New York branch of the Institute of Operating Engineers was organized March 18, at which the following officers were elected: Chairman, Mr. Willis Lawrence, chief operating engineer of the Interborough Rapid Transit Company; secretary-treasurer, Mr. W. P. F. Hill, chief operating engineer of the Woman's Hospital; chairman of committee on educational requirements, Mr. F. C. Flickinger, E.E.; chairman of committee on apprenticeship requirements, Mr. L. M. Glodell, chief operating engineer of the United States Express Building. The branch starts with eighty members. At a meeting of the Mississippi Branch on March 11 papers were presented on "Water Rheostats" and "The Four-Cycle Gas Engine."

Domestic Use of Telephone Receiver Interrupts Service.—The Pacific Telephone & Telegraph Company upon investigating complaints of interruption of service on a farmers' line found that a woman on the line had been in the habit of taking the receiver off her telephone and using it for a darning ball in mending socks.

Mechanical Device for Artificial Respiration.—It is reported that a machine known as a pulmotor, or lung motor, has been brought to this country from Germany by the United States Bureau of Mines to be used in cases of apparent drowning or death by asphyxiation, as in mine accidents. The machine is designed to cause the natural movements of inhalation and exhalation by mechanical means, at the same time giving a carefully measured supply of oxygen to the lungs of the patient. This apparatus should be useful in cases of prostration from electric shock.

Squirrel-Cage Rotor with Automatically Varying Resistance.—In a patent issued on Feb. 21, 1911, to Mr. Burton McCollum a description is given of a squirrel-cage secondary for an induction motor so built that it possesses high effective resistance at starting and low resistance under running conditions, the change in resistance taking place automatically as the speed increases. The end-rings are constructed of an alloy of steel with more than 2.5 per cent tungsten. The inventor states that this material has a low resistance for low-frequency currents and a high resistance for high-frequency currents by reason of the magnetic hysteresis loss and skin effect.

Municipal Ownership Defeated at South Framingham, Mass.—By a failure to muster the necessary two-thirds vote a proposition on behalf of the municipal ownership of the street-lighting system of the town of South Framingham, Mass., was defeated at a special election on March 15. About a year ago the town appointed a special committee to investigate the question of municipal ownership of street-lighting equipment, and at a regular town meeting on March 13 the report, which was favorable to municipal ownership, was accepted by a show of hands. It was necessary, however, to pass upon the issue by Australian ballot, and as a result the previous action was nullified. Under the law the town cannot again vote upon the question for two years. The existing service is supplied by the Boston Edison Company, which owns and operates the equipment.

Completion of Roosevelt Dam.—The Salt River (Arizona) reclamation project was opened officially by Col. Theodore Roosevelt on March 18. The most prominent feature of this government irrigation project is the Roosevelt dam across a canyon through which the upper Salt River flows. The dam, seventy-six miles east of Phœnix, is one of the largest in the world. It is built of masonry and is 225 ft. long at the bottom and 680 ft. long at the top, arching upstream. Its height is exceptional, being 220 ft. The dam is 16 ft. thick at the top and 170 ft. thick at the bottom, containing 339,400 cu. yd. of masonry. The stones are laid in cement which was made on the spot. The dam creates what is said to be the largest artificial lake in the world, and the water-power created is utilized for the generation of electrical energy, to be used largely for operating irrigation pumps to supplement the flow of irrigating water by gravity, as previously described in this journal.

Swedish Telephone Industry in 1910.—The Allmänna Telefon Company, in Stockholm, Sweden, during 1910 increased the number of its subscribers and those of its affiliated companies to 118,000, an increase for 1910 of 14,841, against 11,802 for 1909. The number of subscribers in Stockholm has risen to 58,470, an increase of 4030, against 3511 during the record year of 1906. The value of the output of the L. M. Ericsson works in 1910 was $2,000,000. In this year Ericsson material was supplied for a new main exchange in Paris, two in Baku, Russian Transcaucasia, one in Rotterdam, and orders are on hand for an exchange in Helsingfors, Finland, for 10,000 subscribers, and one in Cape Town, in South Africa. The stations in Calcutta, Singapore, Hong Kong, Buenos Ayres, Santiago and Mexico have been extended. The affiliated companies have now 30,599 subscribers in Moscow, an increase of 4459; 22,445 in Warsaw, an increase of 3466, and 6667 in Mexico, an increase of 2876. The number of workmen employed at the factories in Stockholm, London, St. Petersburg and Buffalo was at the close of the year 1,250, 800, 630 and 200 respectively.

Grounding the Secondary.—Mr. W. L. Puffer, recently professor of electrical engineering at the Massachusetts Institute of Technology, has made a report to the municipality of Hingham on the subject of grounding the secondary. He stated that if all water pipes were of iron he would advise the immediate grounding of the secondary system to such water pipes, as near the transformer as possible, and also at service entrances where it can conveniently be done; but the use of cement water pipes prevents the adoption of this plan except in the very small districts where there are iron pipes. In districts through which the town brook flows, and in any other locality where there are no iron pipes, but where it is known that there is a subterranean water supply, he advises the use of a number of driven pipe grounds all connected to the secondary system. The pipes should be driven well into the moist earth and tested before being used. In other districts he would not advise grounding until such time as tests could be made to determine the practicability of getting a sufficiently good ground connection.

New Officers of National Independent Telephone Association.—At a meeting of the directors of the National Independent Telephone Association held in Chicago on March 14 officers were elected as follows: President, Mr. Manford Savage, Champaign, Ill.; first vice-president, Mr. E. B. Fisher, Grand Rapids, Mich.; second vice-president, Mr. N. G. Hunter, Wabash, Ind.; secretary and treasurer, Mr. J. B. Ware, Chicago. Mr. Savage is a practising lawyer in Champaign and president of the Home Telephone Company of that city. The directors adopted resolutions favoring laws "to compel the interchange of telephone service between different companies and to fix and establish the terms and conditions under which the same may be done." A resolution was also adopted instructing the officers to endeavor to defeat the effort of the Bell company to acquire control of Independent companies in Rochester, Syracuse and Utica, N. Y. Monthly meetings of the directors of the association are to be held hereafter. Mr. F. N. Kondolph, of Rochester, N. Y., resigned as a member of the board of directors and was succeeded by Mr. A. A. Gordard, of Topeka, Kan.

Terminal Electrification and the Chicago Mayoralty.—The campaign for the election of a mayor of Chicago is in full blast, and it appears that the agitation for the electrification of steam-railroad terminals has become involved in it to some extent. One of the two leading candidates is represented to be lukewarm on the proposition, and it is said that many railroad employees are supporting him on that account. Engineers, firemen and switchmen of steam railroads are opposed to electrification, some of them fearing that they will lose their jobs, others doubtless carrying out the wishes of their employers, and some perhaps in genuine fear that electrically equipped railroad tracks would endanger them in performing their daily tasks. It is pointed out, however, that opposition to the improvement on these grounds is due partly to ignorance and partly to the reactionary human tendency that has been a bar to the adoption of all new inventions and all improvements. Electrical operation of Chicago railroad terminals is coming without doubt. But the change will be a slow one, and the operatives will have time to adjust themselves to the new order of things. Furthermore, the danger to life apprehended by the switchmen is greatly overestimated, if it exists at all where modern safety appliances are used.

Electric Heat to Cure the Baby's Croup.—A central-station man has discovered that the croupy coughs of his young son can be relieved in short order by inclosing the baby's crib and placing inside an electric water heater, the steam rising from which moistens the air within and soon cures the croup.

Control of Telegraph and Telephone Companies.—On March 20 the Interstate Commerce Commission announced that all telegraph and telephone companies doing an interstate business are to be regulated under the interstate commerce act and that these companies must file all their tariffs of rates on interstate business and will be held liable for discriminations.

Meter Tests.—During the month of March 669 gas meters were tested on complaint by the New York City Public Service Commission, of which 48.8 per cent ran fast and 10.9 per cent ran slow. Of seventy-seven electric meters tested upon complaint during the same month 2.6 per cent ran fast and 3.9 per cent ran slow, 93.5 per cent being correct within the prescribed limits.

Souvenir of Boston Edison Twenty-fifth Anniversary.—Through the initiative of President C. L. Edgar a souvenir of the twenty-fifth anniversary of the organization of the Boston Edison Company was recently presented to each employee. The souvenir consists of a paper-weight model of the first Edison bipolar generator used on the system, and its completeness of detail, with appropriate inscription, has attracted much favorable comment.

A Telephone Auto Horn.—To the terrors of the automobile horns there are now added those of the phonograph. Mr. A. C. H. Dalley, of Minneapolis, has arranged an indestructible phonograph record in combination with a loud-speaking telephone to be mounted on the front of the automobile, a touch of the chauffeur's button causing the new auto horn to hurl in raucous notes at fleeing pedestrians the name of its car or any other phrase desired.

Proposed Ohio Hydroelectric Plant.—The Miami Power Company, of Hamilton, Ohio, recently incorporated, proposes to erect a 5000-hp hydroelectric plant on the site of the old Chatfield & Woods paper mill at Woodsdale. The plant, it is said, will cost about $500,000, and energy will be furnished to Hamilton, Middletown, Miamisburg and Franklin. The incorporators of the company are Messrs. H. L. Hanley and J. W. Durfue, of Chicago; W. D. James, of Detroit, and William Bergen and John Reif, of Overpeck, Ohio.

Electric Service for Ranches.—Contracts have been closed at Grand Junction with the Grand Valley Interurban Company by ranchmen residing in the Pomona district northwest of Denver for electricity for lighting and heating their homes and reclaiming hundreds of acres on Pomona Heights, on which no water can be secured at present. The ranchmen have contracted for enough energy from the trolley wires to secure a low rate, and a transformer will be installed to reduce the voltage so that it can be used for domestic purposes.

South Side Park and Boulevard Lighting in Chicago.—The South Side park commissioners of Chicago announce that they will accept the proposal of the Sanitary District to supply electrical energy for lighting the South Side parks and boulevards. The existing steam-generating plant in Washington Park, which is of recent design, will be shut down and held as a reserve. The Sanitary District, which operates the hydroelectric plant of the Chicago Drainage Canal, supplies electricity to Lincoln Park, on the North Side, at the present time.

Institute of Operating Engineers.—The second monthly meeting of the Institute of Operating Engineers was held March 9 in the Engineering Societies Building, New York, at which a paper was presented by Prof. W. D. Ennis. At the regular monthly meeting in April, Mr. J. C. Jurgensen will present a paper on "Economical Aspects of the Institute of Operating Engineers."

Denver Electric Show.—The chairmen of the various committees having in charge the conduct of the annual Denver electric show have reported the appointment of members for their committees and definite arrangements have been made to secure the Denver Auditorium for the exhibition from Oct. 14 to 21, inclusive. The publicity committee consists of Mr. L. T. Greenewalt, publicity representative of the Colorado Telephone Company, chairman; Messrs. John M. Connelly, publicity representative of the Denver Gas & Electric Company, and W. J. Canada, electrical engineer of the Rocky Mountain Fire Underwriters' Association.

Railroad Conventions in Chicago.—A stated meeting of the Railway Signal Association was held in the Congress Hotel, Chicago, on March 20. Committee reports on signal symbols and on detailed specifications for material were discussed, while papers were presented on portable storage batteries for automatic signals and on the principles governing the selection of alternating-current signaling apparatus. On March 21, 22 and 23 the American Railway Engineering and Maintenance of Way Association held its convention. The Railway Appliances Association is holding its annual exhibition of railroad appliances at the Coliseum, Chicago, during the week ending March 25.

Relative Globe Surface of Large Tungsten Lamps.—A partial explanation of the tendency of very large tungsten lamps to blacken more than the medium-sized units was offered by Mr. H. Schroeder, of Harrison, N. J., in a discussion at the St. Paul convention of the Minnesota Electrical Association, March 15. The 25-watt tungsten lamp has a globe surface of about 25 sq. in., or 1 sq. in. per watt of power dissipated. The 500-watt unit, however, would require a globe about 13 in. in diameter to secure the same ratio. The 8-in. size, in which the lamps are made, requires the dissipation of about 4 watts per square inch of globe surface, and this greater intensity of action on the surface of the large-size globes is in part held accountable for the tendency to discolor.

Value of Illinois Engineering Experiment Station.—Before the Western Society of Engineers in Chicago on March 15 Prof. W. F. M. Goss, dean of the College of Engineering, University of Illinois, read a paper on "The Illinois Engineering Experiment Station in Its Relation to the Public." The work done by the experiment station at Urbana was outlined and illustrated by lantern-slide pictures showing various types of testing apparatus and equipment. Forty-four bulletins had been issued by the experiment station, and there seems to be no question of their value to the technical interests of the State. The paper, therefore, dealt with the subject from the viewpoint of the general public. The two main investigations outlined for the future relate to fuel and its utilization and to materials of construction. Other questions to be investigated are the utilization of electricity for agricultural and mechanical purposes, gas production and gas power, transportation, pneumatics and aeronautics. So far the laboratory has not undertaken to make tests for private enterprises, and it is not the intention to enter into competition with established testing laboratories. The Legislature is asked to appropriate sufficient funds to enable the work of the station to be increased, as the present laboratory facilities are inadequate. Messrs. W. L. Abbott, Albert Scheible, W. E. Symons, A. Bement, W. Morava, Charles F. Burgess and E. E. R. Tratman took part in the discussion. It was pointed out that unbiased experiments undertaken to settle technical questions are of great economic importance.

Electrical League of Cleveland to Give a Smoker.—The Electrical League of Cleveland will give a smoker and entertainment in that city on Saturday, April 1. An interesting program is in preparation.

Electrical Talks for Boys.—Talks on technical subjects have been a feature of the work of the children's department of the Fort Wayne (Ind.) Public Library during the winter season now closing. Two of them related to electricity, the lecturers using non-technical language and giving demonstrations. It is observed that the boys take a real interest in these talks and that the number reading electrical books has been sensibly increased.

Chicago Section of Illuminating Engineering Society.—Mr. James R. Cravath read a paper on "Tests on Lighting of a Small Room" at the meeting of the Chicago Section of the Illuminating Engineering Society held on March 16. The next meeting of the section will be held on April 20, when Mr. C. R. Gilman, of the Chicago, Milwaukee & St. Paul Railway Company, will read a paper on "Recent Developments in Car and Train Lighting."

Chicago Aldermen Watching Commission Legislation.—A special committee of the Chicago City Council has been appointed by the Mayor to protect and advance the powers of the City of Chicago in the regulation of public-utility corporations as they are affected by bills now pending before the State Legislature. The committee consists of Alderman W. J. Pringle, chairman of the City Council committee on gas, oil and electric light, and six other aldermen.

Intermittent Lighting Service Caused by Atmospheric Disturbance.—According to the newspapers a severe electrical storm near Bakersfield, Cal., affected the transmission lines of the Southern California Edison Company in such a manner that at intervals of from fifteen seconds to two minutes the lights on customers' premises in Los Angeles were put out, flashing on again an instant later. This phenomenon is said to have lasted from about 9 o'clock until midnight on the night of March 2.

Treasure Trove to the Extent of 50 hp.—County officials in Los Angeles recently discovered a provision in an old but still valid franchise by which the Pacific Light & Power Company is required to supply to Los Angeles County 50 hp in electrical energy in perpetuity. The attention of the company was called to the matter and General Manager A. C. Balch responded by saying that the company stood ready to meet the condition. The Board of Supervisors, at the last account, was considering where to make use of this "find" of electrical energy.

Ohio Ice-Making Auxiliaries.—Credit was inadvertently given to Ohio in the article on central-station ice-making auxiliaries, printed in the issue of March 2, for only a single plant having an ice-making auxiliary. There are at least four such plants in that State, two of which have been described in these columns, namely, that of the Marysville Light & Water Company, Marysville, Ohio, and the Loveland Citizens' Electric Company, Loveland, Ohio. Other plants are operated by the Hillsboro Light & Fuel Company and the Maumee Electric Company.

Electric Furnaces at the Universtiy of Illinois.—There have recently been installed at the University of Illinois, through the combined efforts of the department of electrical engineering, the engineering experiment station and the department of chemistry, two electric furnaces. One of these is a Hoskins resistance furnace and the other a Colby induction furnace. Both are of 20-kw rating. The furnaces will be used for the purpose of studying the changes that can be brought about in the chemical and physical characteristics of cast iron through the influence of the soaking process which it is possible to maintain by their use.

Gary Aldermen Object to High-Potential Railway Wires.—By vote of the City Council of Gary, Ind., on March 13, the Mayor of the city was directed to cause the removal of the overhead wires and cables of the Chicago, Lake Shore & South Bend Railway Company within the city limits. This company, operating a single-phase alternating-current railway system, employs a transmission voltage of 33,000 and a trolley voltage of 6600. Its line runs from Pullman, in the southern part of Chicago, to South Bend, Ind., passing through Gary. The officials of that city consider that the high-potential wires are dangerous.

Flectric Club of Chicago.—Mr. Charles E. Merriam, professor of political science in the University of Chicago and a candidate for Mayor of that city, addressed the Electric Club of Chicago at its luncheon on March 15. Over 100 members and guests were present. Mr. Merriam made a non-political speech on "The Needs of Chicago," speaking of the "graft," political favoritism and lack of business methods which, he said, have characterized the city government for a number of years back and asserting the need of intelligent attention to matters of administration as well as of legislation. The entertainment committee of the club was authorized to arrange for a smoker to be held at the Illinois Athletic Club some evening next month.

An Unexpected Test for "Wireless."—The disastrous powder explosion at Pleasant Prairie, a hamlet fifty-five miles north of Chicago, on the evening of March 9 caused a tremor over a wide area, including Chicago. The hundreds of "wireless" operators in and near Chicago "got busy" at once. Messages were exchanged between Chicago and Milwaukee and with boats on the lake. At first it was thought that an earthquake had happened, but soon the operator of the United Wireless Telegraph Company at the Congress Hotel station, Chicago, sent out a newspaper bulletin stating that the "shake" was due to the explosion of powder mills. The excitement was thus allayed so far as those who had access to the "wireless" reports were concerned. Many extra calls, probably amounting to thousands, were made by telephone in Chicago and other cities and villages as the result of this accident. The operators of the Chicago Telephone Company were informed quickly of the cause of the trouble and anxious subscribers were told that there was a powder explosion near Kenosha, Wis.

Extension of Plant of Utah Light & Railway Company.—The Utah Light & Railway Company, Salt Lake City, is completing a steam-reserve power station at Jordan River, which will serve as a reserve against breakdown or other interruptions, the plant not to be operated continuously. The present equipment consists of a 6800-kw Westinghouse turbo-generator having a twenty-four-hour overload capacity of 7500 kw and a temporary overload capacity of 8500 kw. The cubical capacity of the plant is a little over 56 cu. ft. per kilowatt, against an average of between 75 cu. ft. and 80 cu. ft. for similar plants. The line connecting the plant with the general electrical system of the company is of the latest steel-tower construction. At present the Utah Light & Railway Company is supplied with electrical energy principally from the Pioneer power station in Ogden Canyon, thirty-seven miles north of Salt Lake; the Cottonwood Stairs station, sixteen miles southeast of Salt Lake; the Cottonwood Granite station, fourteen miles southeast of Salt Lake; the Bear River station, eighty-five miles north of Salt Lake, and from the Telluride hydroelectric system. In addition the company has three steam plants in Salt Lake City. During the past year there was added to one of these, the old Jordan station, a low-pressure turbo-generator, utilizing the exhaust steam from the old reciprocating engine, thereby practically doubling the output for the same fuel consumption.

The Ohio Society of Mechanical, Electrical and Steam Engineers.—The semi-annual meeting of the Ohio Society of Mechanical, Electrical and Steam Engineers will be held in Youngstown, Ohio, on May 18 and 19. Mr. Oscar F. Rabbe, Toledo, Ohio, is president and Prof. Frank E. Sanborn, Columbus, Ohio, secretary-treasurer.

Felling Trees Electrically.—The name of the inventor of the method of felling trees electrically, described in the issue of Feb. 2, 1911, is Hugo Gantke, and his address is 52 Heidestrasse, Berlin, N. W., Germany. He has no representative in this country. This information is given owing to the apparent interest in the article as indicated by inquiries where the apparatus employed in this method of tree-felling may be obtained.

Damage from Transformer Oil.—The Edison Electric Illuminating Company of Boston is the defendant in a suit for damages brought as the result of a very unusual combination of circumstances. Oil from a pole transformer in the residence section of Chelsea by some peculiar accident ran out along the wires and was blown against the residences, forming spots of various sizes. The owners have asked for $5,000 in damages.

Electrical Jobbers' Convention.—Arrangements have been completed for a special train from Chicago to convey the members of the Electrical Supply Jobbers' Association to Del Monte, Cal., where the association will hold its convention on April 25, 26 and 27. The train will leave the Dearborn Station, Chicago, at 8 p. m. on April 18 over the Atchison, Topeka & Santa Fé Railway. Stops will be made at Albuquerque, N. M., the Grand Canyon of Arizona and Los Angeles, Cal. Mr. Franklin Overbaugh, general secretary of the association, will take personal charge of the train party.

New Method of Producing Vector Diagrams.—At a special meeting of the Boston Section of the American Institute of Electrical Engineers, held in Pierce Hall at Harvard University on Saturday, Feb. 25, Dr. A. E. Kennelly, assisted by Messrs Crane and Doggett, gave a lecture demonstration on a new direct method of producing vector diagrams of an alternating-current circuit experimentally. By means of a suitably arranged alternating-current circuit containing apparatus designed by Dr. Kennelly the voltage and impedance diagrams of the circuit were produced visually. An account in detail of the new method will appear in a later issue of this journal.

Illumination Club of St. Paul.—Employees of the Northern Heating & Electric Company, of St. Paul, Minn., and the St. Paul Gas Light Company, together with a number of local architects, engineers, draftsmen and contractors have formed the Illumination Club of St. Paul, which holds monthly meetings for the discussion of papers on illuminating engineering subjects. Mr. A. L. Abbott is president of the club and Mr. C. M. Converse, of the St. Paul Gas Light Company, is secretary-treasurer. On Monday evening, March 13, Mr. Converse presented a paper on "Theater Lighting." On April 10 Mr. E. T. Street will lead a discussion on the subject of "Indirect Lighting."

N. E. L. A. Commercial Section.—The climax of the wide campaign for new members which is being waged by the Commercial Section of the National Electric Light Association will take place on Monday evening, June 1, at the Hotel Martinique, New York City, where a banquet will be tendered by Mr. George Williams and Mr. J. Robert Crouse to all who have had a part in the campaign. The main feature of the banquet will be a presentation of a sterling silver loving cup donated by Mr. Crouse to the person who succeeds in securing the largest number of new members. The contest for the cup will not cease until midnight on May 31. Each contestant's name, together with the number of members he has secured, will be posted at one end of the banquet hall. All the committee men of the Commercial Section have been enrolled ex-officio as participants in the cup contest. The list of new members grows steadily from day to day, and the committee is particularly gratified at the way in which men of the highest standing in the electrical manufacturing and central-station industries are falling into line.

Winnipeg Electrical Property Offered to the City.—As a means of settling the questions in dispute between it and the city, the Winnipeg (Man.) Electric Railway, through its president, Sir William Mackenzie, has offered its railway, electric light and gas properties to the city as a going concern. The basis on which control is offered is said to be $250 a share, whereas the present market quotation is $190. The cost to the city would, therefore, be over $15,000,000. The Mackenzie interests agree to purchase from the city 15,000 hp as soon as the hydroelectric station now being erected at Point Du Bois Falls is completed on condition that the Winnipeg Electric Railway be permitted the exclusive right to engage in commercial lighting. It is claimed that the price offered for the energy will pay interest on the city's entire investment in the municipal plant mentioned.

Annual Meeting of New England Section, N. E. L. A.—The annual meeting of the New England Section of the National Electric Light Association was held at the Edison Building, Boston, on March 17. In accordance with a vote cast by members all technical features were omitted, the reason being the proximity of the New York convention of the national organization at the end of May. The following officers were nominated and elected for the ensuing year: President, Mr. Howard T. Sands, Malden Electric Company, Malden, Mass.; vice-president, Mr. A. B. Lisle, Narragansett Electric Lighting Company, Providence, R. I.; treasurer, Mr. Welles E. Holmes, Cambridge Electric Light Company, Cambridge, Mass.; secretary, Miss O. A. Bursiel, Boston, Mass. The following members of the executive committee were elected: Messrs. J. A. Fleet, Portland Electric Company, Portland, Maine; J. S. Whitaker, Rockingham County Light, Heat & Power Company, Portsmouth, N. H.; A. F. Townsend, Woonsocket Electric Machine & Power Company, Woonsocket, R. I.; R. W. Rollins, Hartford Electric Light Company, Hartford, Conn.; George S. Haley, Rutland Railway, Light & Power Company, Rutland, Vt.; L. D. Gibbs, Edison Electric Illuminating Company, Boston, Mass., and, ex officio, Past-president A. J. Campbell, New London Gas & Electric Company, New London, Conn.

Electrification of Railroads Discussed at Boston.—At the annual meeting of the Boston Society of Civil Engineers, held at the Boston City Club on March 15, steam-railroad electrification was discussed by Prof. George F. Swain, of the Boston Transit Commission; Mr. W. S. Murray, electrical engineer of the New York, New Haven & Hartford Railroad Company, and President Dugald C. Jackson, of the American Institute of Electrical Engineers. Professor Swain reviewed the recent report of the Joint Commisison on Metropolitan Improvements, and discussed the reasons which led the majority of the board to advise no legislation compelling the adoption of electric motive power at the present time. Mr. Murray exhibited a large number of lantern slides showing the evolution of electric traction on the New Haven system, and gave a number of instances to show the advantages of high-voltage transmission in trunk-line service. Professor Jackson doubted if electricity is a luxury in handling heavy transportation, when all factors are considered, including the economic loss due to the smoke nuisance. All the speakers agreed that the proposed purchase of the Boston, Revere Beach & Lynn Railroad Company and the building of a tunnel under Boston Harbor by the New Haven interests will, if permitted by the Legislature, mark the beginning of electrification at Boston, since the tunnel and its approaches must of necessity be electrically operated.

ELECTRIFICATION OF THE PULLMAN PASSENGER-CAR SHOPS.—I.

The Modern Plant That Has Superseded the Famous "Centennial" Corliss Engine.

BY GEORGE W. CRAVENS.

THE Pullman Company is too well known to require extended introduction, as it is the largest institution of its kind in the world, but the recently completed general electrification of its principal car shops at Chicago is worthy of especial notice, not only owing to the intrinsic interest of the new equipment itself, but because of the remarkable mechanical transmission system formerly in use in these extensive shops.

When the late George M. Pullman founded this organization it was for the purpose of building his patented sleeping-cars. To-day practically every known type of car for steam-railroad passenger service is built by the Pullman Company, both of wood and of steel, together with electric, street-railway and freight cars and cabooses. The use of steel for car-building has spread until a majority of cars now have steel sills, many have steel frames with wood finish and an increasing number are entirely of steel except cushions and windows. This growth and change have demanded increased power and space and a reorganization of methods.

Fig. 1—General Interior View of New Central Power Plant, Pullman.

GENERAL DESCRIPTION OF SHOPS.

The principal works of the Pullman Company are located in the southern part of the City of Chicago and lie between the main line of the Illinois Central Railroad on the west and Calumet Lake on the east, a distance of about one-half mile, and from Ninety-eighth Street on the north to 117th Street on the south, making the length approximately two and one-half miles. This covers most of what was formerly the town of Pullman. Aside from a few sheds all buildings are of brick with slate roofs, the later ones having steel frames, and some of them being provided with concrete slab roofs.

The passenger-car shops constitute over half of the plant, the principal buildings being so placed that transfer tables run between them and serve the buildings on each side. These transfers are steam-driven and will probably remain so. Extensive trackage is provided throughout the yards and into all of the main buildings. The buildings comprise steel and wood car-building shops, carpenter, machine, brass-finishing, foundry, wheel and axle shops, storerooms, upholstery, pipe, paint, glass and miscellaneous shops and lumber and metal storage buildings, together with offices and power plants. The new central power house, to be described later, is shown in Fig. 2, a general interior view being given in Fig. 1. There are about 12,000 men employed in the passenger-car shops at present, and the capacity of this portion of the plant is 150 cars a month, of which about one-half may be all-steel cars. The passenger-car shops occupy most of the territory between 140th Street and 111th Street, one corner still containing some of the buildings forming the town of Pullman. There are still occupied by shop men and their families.

The new steel freight-car shops have been built just north of the older passenger-car shops and occupy the space between Ninety-eighth Street and 104th Street. Up to date these consist of three buildings and some sheds, the main building being 400 ft. wide (four bays of 100 ft. each) by 1175 ft. in length, with the roof composed largely of glass. In these shops will be placed the necessary equipment for making steel freight cars of all types, and about 3000 men will be required when running full. At present only a few machine tools are in place

and about seventy-five men are employed on steel passenger-car parts. The wheel-and-axle shop at this plant is located next north of the main shop and the power and mechanical building next south of it.

This power plant for the steel freight-car shops (distinct from the central power plant) contains two Westinghouse 1000-kw, 440-volt, 60-cycle, three-phase turbo-generators of the horizontal type, with space for a third one. One steam-driven and two induction-motor-driven exciters are provided for, together with two 500-kw motor-generator sets for supplying 220-volt direct current. Most of this direct current will be for the cranes, of which there will be over a dozen in these shops. This plant also contains two air compressors, each delivering 4000 cu. ft. of free air per minute at a pressure of 100 lb. per square inch, with space for a third one, and a hydraulic pump delivering water at a pressure of 1000 lb. per square inch to the hydraulic presses in the main machine and car shop. This water passes through a steel pipe 1500 ft. in length, laid in a tunnel and fitted with an accumulator and shock absorbers.

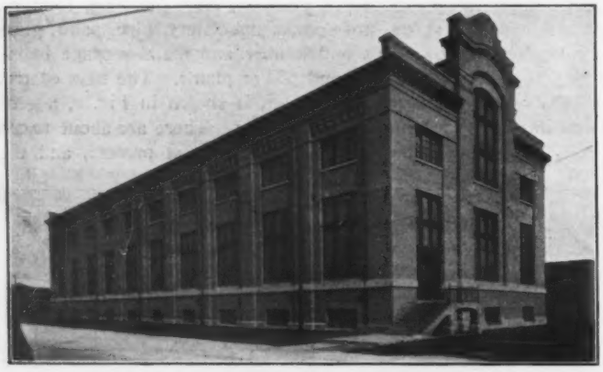


Fig. 2—New Central Electric Power Plant at Pullman.

In addition to the usual steam auxiliaries required there is an oil-switch and bus compartment in the basement. The oil switches are mounted on pipe framework and operated by hand from the main switchboard, which is directly above in the main engine-room. The board is of white marble and, together with the switches, was built by the Westinghouse Electric & Manufacturing Company and installed by Kohler Brothers, of Chicago. The main buses are of bare copper bars carried on insulators suspended overhead in the basement and in a special framework overhead in the switch compartment. Connections to the feeders are through insulated cables laid in conduits.

The power plant at the steel freight-car shops is not yet completed and the power generated is controlled from a temporary switchboard. Most of the power is now transmitted to the passenger-car shops through 440/2300-volt step-up transformers and a temporary tie-line. This tie-line consists of some old No. 4 B. & S. weatherproof wire mounted on wooden poles with glass insulators. Further reference will be made to this tie-line in describing the new 2300-volt power plant, or central plant, at the passenger-car shops, to which the present article is devoted principally.

The Calumet repair shops are located just south of the passenger-car shops and extend from 111th Street to 117th Street. A part of this territory is also occupied by some of the old town of Pullman. It is here that all repairs are made to the cars operated by the Pullman Company, and as many as 2000 men may be employed here in busy seasons. The equipment is similar to that of the passenger-car shops, but on a smaller scale. Electrical energy for these shops comes from the new central power plant, the cables being laid in conduits. Further details of this equipment will be given later.

The new central power plant is located at the passenger-car shops and near the "center of gravity" of the load. Just at present the load is largely to the south of the power house, due to the burning of the old freight-car shop, but it is expected that more energy will be sent north later. Before describing this plant, however, a description of the old power equipment will be given in order better to contrast the old and the new.

OLD POWER EQUIPMENT.

The Pullman Company shops were started before the days of practical electrical transmission of power, so the machinery in the various buildings was driven by steam engines with power supplied from boiler plants located throughout the grounds. As the plant expanded new boilers were added until finally there were twenty of them, of various kinds and sizes, scattered about the shops. This was so wasteful and inconvenient that a new central boiler plant was built in 1906 to concentrate steam generation in one place and increase efficiency. This is located near the center of the passenger-car shops and it is housed in a brick building 80 ft. x 131 ft. in size, provided with a 250-ft. circular brick stack just outside the east end of the building. This stack produces a draft equal to 1¾ in. of water at its base, with a minimum equal to 1½ in. of water in the breechings. Fig. 3 is an interior view in the central boiler house.

All coal and ashes are handled by automatic conveyors, the coal being delivered in cars on a track alongside the building, dumped into a hopper, conveyed to the continuous steel bunker overhead in the central section of the building and thence through 16-in. steel chutes to the hoppers of the stokers on the furnaces below. The bunker is built with sixteen hopper bottoms, in two rows of eight each, twelve of which are for coal, two for shavings and two for ashes. The building is equipped with four shaving separators on the roof for feeding one of the present boiler furnaces, and about 60,000 cu. ft. of shavings is burned each twenty-four hours. The coal-handling apparatus has a capacity of forty tons of coal per hour.

At present there are installed eight 400-hp Stirling water-tube boilers in a single row, along one side of the building, facing the center of the room. Space is provided for as many more on the opposite side of the room, and three of these boilers will be installed at once. These are now in the boiler-room of the old freight-car shop, which burned about a year ago, but are being dismantled preparatory to moving. Six of the boilers now in place have Green automatic chain stokers, the other two having straight fixed grates, with ½-in. air-space openings, and being used for burning shavings.

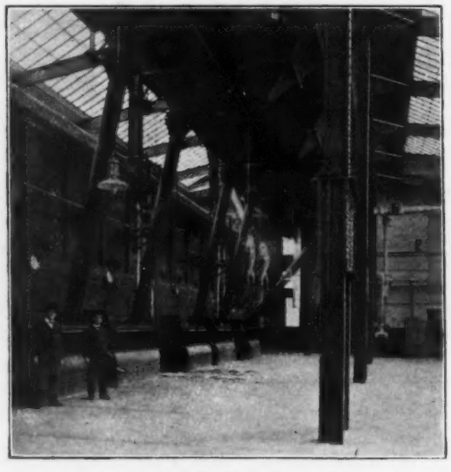


Fig. 3—Interior of Central Boiler House, Pullman.

The water for this boiler plant may be taken from the city mains or from the company's own supply system. The feed water is heated in a Cochrane 4000-hp heater and supplied through an automatic tandem-compound 16-in. x 25-in. x 12-in. x 20-in. pump built by the American Steam Pump Company. The supply to each boiler is controlled by a Murray automatic valve, this in turn being actuated by a float in the water column of the boiler.

From each boiler an 8-in. connection runs to a 20-in. main steam header which runs along the wall at the back of the boiler settings. In each connection there is an 8-in. gate valve and an 8-in. automatic stop and check valve, the latter to prevent back pressure reaching the boilers. There are also two 4½-in. blow-off valves on each boiler. All of the valves on the steam and feed-water pipes may be reached from an iron-slat walk which extends along over the rear of the boiler settings just in front of the 20-in. heater. Before the new central power house was built steam was supplied to the various engines about the shops through overhead mains from this plant. Some of these steam pipes were 1000 ft. long and all of them were covered with double thicknesses of 85 per cent Keasbey & Mattison magnesium pipe covering.

This boiler plant has been described because it will continue in use for the new central power plant, and after the three other boilers are installed it will supply all of the steam for use in the passenger-car shops and offices. Messrs. R. W. Hunt & Company were the consulting engineers when this plant was built, and the engineers of the Pullman Company are handling the changes and extensions. In addition to the three old boilers mentioned these extensions will also include coal and ash conveyors and other auxiliary equipment.

THE CENTENNIAL CORLISS ENGINE.

In addition to the steam engines located at various places about the shops there has been in use also a remarkable system of underground shafting for power transmission. This was actuated by the old upright Corliss two-cylinder engine originally exhibited at the Centennial Exposition held at Philadelphia in 1876. This faithful worker stands in its own room, at the north end of shop No. 2, quite near the office building, silent, waiting to be destroyed, giving mute testimony of times passed away. It is illustrated in Fig. 5.

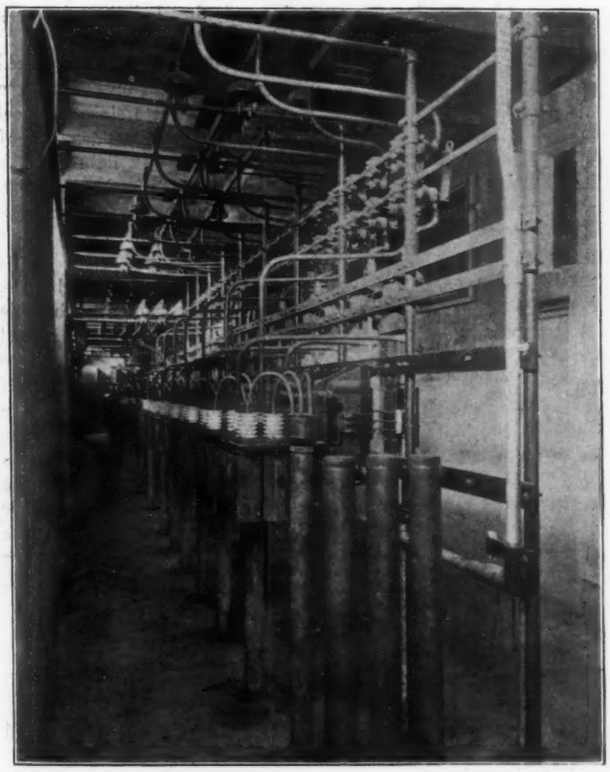


Fig. 4—High-Tension Compartment.

This engine is of the walking-beam type, the cylinders each being 40 in. diameter with 10-ft. stroke. It is provided with air pumps and condensers and may be worked either condensing or non-condensing, and was designed to work at a pressure ranging from 25 lb. to 80 lb. Each cylinder was designed to develop 700 hp at 36 r.p.m., nominal, giving 1400 hp total, but the engine has delivered over 2000 hp at times.

The height of this engine is 39 ft. from the floor to the top of the walking beam and it weighs complete over 800 tons. The beams are made of cast iron, 9 ft. wide in the center and 27 ft.

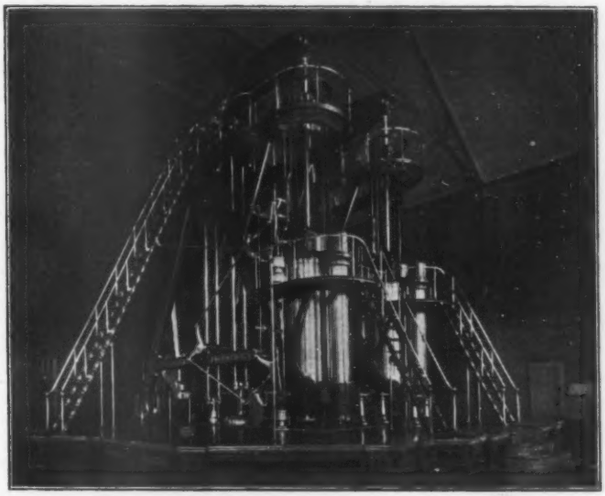


Fig. 5—The Famous "Centennial Corliss," Now Superseded.

long, and weigh eleven tons each. The cross-head guides extend from the upper heads of the vertical cylinders to the gallery around the top and may be lifted off with the cylinder heads for access to the pistons. The piston rods are of steel 6¼ in. in diameter and the connecting rods are 24 ft. long. The main frame is A-shaped, with the journals for the beam shafts on top and with one leg resting on the cylinder base and the other on the main crankshaft journal-box pedestal.

The flywheel is 30 ft. in diameter with 2-ft. face and weighs fifty-six tons. It has gear teeth in the center of the face and meshes with a pinion 10 ft. in diameter weighing eight and one-half tons. This pinion is mounted on a 14-in. steel shaft below the floor and is the beginning of the underground transmission line already mentioned.

In the same building is a 150-kw, 2300-volt, three-phase Westinghouse generator direct-connected to a horizontal engine. This is no longer used, as it also has been superseded by the new power plant. The 4000-cu.-ft. air compressor formerly in this building has been moved to the new power plant.

OLD ELECTRICAL AND MECHANICAL EQUIPMENT.

Near the central boiler plant is the old electrical building, in which were installed ten fifty-light and two thirty-five-light, 7½-amp Wood direct-current arc machines, two Edison bipolar 60-kw, 110-volt direct-current generators for three-wire 110/220-volt operation, and a 250-kw Bullock 2300-volt alternating-current generator. All of the Wood arc and Edison machines were on a gallery and driven by belts coming up through the floor from a countershaft with clutches below. This shaft was driven by three upright Corliss engines, through belts, and the Edison and Bullock generators were belt-driven from this shaft without clutches. The arc and direct-current switchboards were on the gallery and all wiring was open.

From the large pinion driven by the Centennial Corliss engine (Fig. 5) a steel line shaft extended for approximately two miles through tunnels to all parts of the plant. This shaft ran at a speed of 108 r.p.m., nominal, and transmitted as much as 2000 hp at times. This shafting was of various sizes, there being 6-in., 8-in., 10-in. and 14-in. diameters at different places. At every right-angle turn there was a pair of bevel gears 6 ft. in diameter (Fig. 6), there being eight pairs of these all together. Belts ran up into the various shops, from pulleys on the underground shaft, for driving the miles of countershafting. These belts were of all sizes up to 48 in. in width, and idlers were used as tighteners instead of having clutches for throwing them in and out of service. It has been estimated that

nearly 350 hp was lost in this underground transmission system.

The old electrical distribution system consisted of both lead-covered and rubber-covered cables, of various sizes up to 500,000 circ. mil, a portion being underground. There was one 500,000 circ. mil overhead direct-current line for the shops and a line for the 2300-volt alternating current overhead, carrying 250 kw from the Bullock generator. Nearly all of the old lighting was with series arc lamps, both in the shops and in the yards, although a large number of incandescent lamps on flexible cords were used in the car shops. Throughout the shops there were about thirty-five direct-current motors and fifty-five alternating-current motors of various sizes.

From the foregoing general description of the old equipment it will be easy to see that a very radical and comprehensive change of power system was desirable. Not only was the old system inadequate to meet demands for extension, but it was inefficient as to generation, transmission and utilization. It was also expensive to operate and maintain, inaccessible in case of breakdown, and there was an inherent lack of co-operation between the different elements all along the line. On the other hand, this equipment was the best of its kind when installed, and the good service rendered is proof of the sound judgment of those responsible for its selection and care.

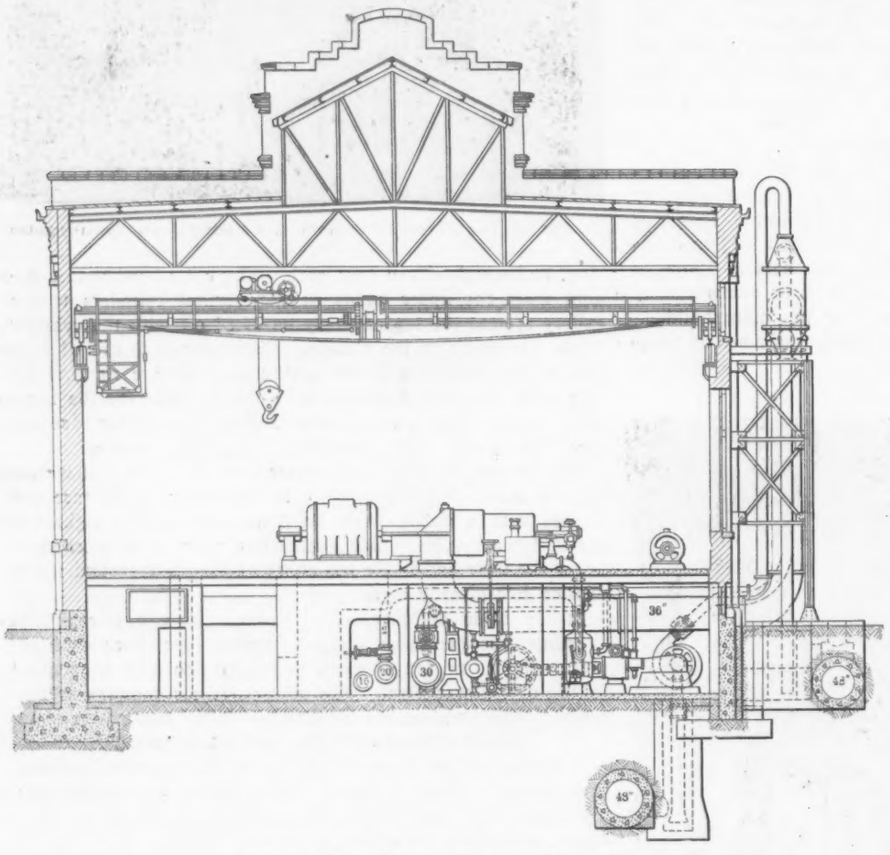


Fig. 6—Cross-Section Through Power House.

THE NEW CENTRAL POWER PLANT.

The new central power plant for the passenger-car shops, shown in cross-section in Fig. 6, is located near the load center and about 200 ft. from the central boiler plant. The building is of red brick, 65 ft. x 180 ft. inside, on a concrete foundation, and has a grass plot all around it. The foundation is very heavy and extends 6 ft. above grade with openings from tunnels into basement at each end. The foundations for turbo-generators and air compressors are also of concrete, very massive and with openings for piping, etc., as are also those for the numerous steam auxiliaries in the basement.

Along the west side of the basement, extending half the length of the building, a room has been partitioned off by a wall of concrete for use as a high-tension compartment (Fig. 4). In this room are the oil switches and 2300-volt buses. At the south end of this compartment a large opening has been made for the entrance of a galvanized-steel duct. This brings in fresh air, which passes from this room through ducts leading up to the turbo-generators for ventilation, the rotors acting as the fans and creating a strong draft.

Built into the walls and floors of the basement are conduits for wires. These lead from the generators and auxiliaries to the high-tension compartment and slot under switchboard, and extend above the floor of the basement up to the level of the oil switches and their supports. These conduits are of iron for small wires and fiber for large cables. Two pits have been constructed in the floor of the high-tension compartment, into which all cables are carried, making convenient places for changing connections, etc. These pits have sectional cast-iron covers.

The superstructure of the power house is of red brick with stone trimmings and is dignified and attractive in design. The walls are faced inside with glazed white-enameled bricks, and the windows are large and glazed with frosted glass. The floors are finished with white tiling laid on the concrete body, and strips of rubber matting have been laid along the principal passageways. The steel work and roof have been painted a light blue and the window casings a very dark color, so the interior of the building is very bright and pleasing.

The floors are of reinforced concrete on steel I-beams and the roof is of concrete slabs on steel purlins. The roof trusses are of steel and a large skylight extends the full length of the building. This skylight has glazed swinging sash in the sides and runs along the center of the roof. The crane girders are mounted on a corbeled shelf along each side wall and windows are placed above them.

Just outside the west wall of the foundation, and alongside the high-tension compartment, there is a large manhole, or vault, which forms the starting point for the underground electrical distribution system. From this manhole there start three sets of ducts, two of Orangeburg fiber and one of tile, each with sixteen ducts running to other vaults about the plant. There are also two sets of Orangeburg ducts from this vault through the basement wall, each composed of twenty-four ducts, leading to one of the pits in the floor of the high-tension compartment. From here conduits run to the other pits, oil switches, generators, etc., as will be described in detail later.

As mentioned above, there is also a tunnel entering each end of the basement. This is approximately 6 ft. high by 10 ft. wide and carries steam and water pipes for all purposes. This runs to the power house from the boiler house and then on to the steel passenger-car shops "A" and "B," about 1000 ft. in total length. There are all told about eight miles of tunnels of various kinds throughout the shops, most of which have been used for many years.

[Mr. Cravens' article will be concluded by Part II, to be published next week.]

PROTECTION AFFORDED BY ARCING RINGS ON TRANSMISSION LINES.

By L. C. NICHOLSON.

A PAPER read before the American Institute of Electrical Engineers at Charlotte, N. C., in March, 1910, described the effects of lightning upon the 60,000-volt transmission lines of the Niagara, Lockport & Ontario Power Company and showed the marked degree of relief obtained by applying metal arcing rings to the insulators, as shown in Figs. 1 and 2.

The object of these rings is to save the insulator from injury by the power arc following a flashover by lightning. They are placed in position to attract the arc and hold it sufficiently removed from the porcelain to prevent breakage by the heat engendered. The rings also tend to prevent puncture of insulators without lowering the effective insulation of the line.

At the time the above-mentioned paper was read experience with this device was limited to the results obtained on about one-half the transmission system (200 miles of line) during one lightning season, that of 1909. There are now available the results of the season of 1910, which was a severe one and during which practically the entire system (410 miles of line) was equipped with arcing rings.

The conditions in 1909 were that one line, containing about 12,000 insulators, was reinsulated—that is, all insulators were removed, tested at dry flashover (200,000 volts) and returned to the line. The failures, 40 per cent of the total, were replaced by a shorter four-part 14-in. insulator, shown in Fig. 2, installed on the top wire. Arcing rings were put on all the retested and new insulators on this line. The insulators of the other line were not retested or protected by rings or otherwise.

The season of 1909, which was rather below normal in point of severity, disabled fifty-four insulators on the old line and one on the retested protected line. The single failure on the protected line was caused by the power arc not properly transferring to the ring, which was improperly installed. The breakage on the old line was practically in duplication of that obtaining in previous years, the number of insulators destroyed being a fair index to the quantity of lightning.

These entirely satisfactory results recommended placing arcing rings on the second line, which was done before 1910. The insulators, however, were not retested, the rings being applied to the insulators in place on the line.

Fig. 1—High-Tension Insulator Equipped with Arcing Ring.

The season of 1910 proved to be equivalent to that of 1908, both of which were severe, so that a direct comparison of the results of the two years indicates the effectiveness of the protective measures adopted. In 1908 220 insulators were destroyed, thirty-one, it was determined, from direct lightning strokes, judging from the characteristic manner in which they were broken up; 114 were punctured, and eighty-one were destroyed by power arc following spillovers. In 1910 twenty-six insulators were lost, seventeen by direct stroke and nine by puncture None was destroyed by power arcs on either line and none by puncture on the reinsulated line. The loss by direct stroke was practically equally divided between the two lines. Momentary voltage disturbances and line trip-outs accompanying discharges on the line have not been increased by the introduction of the arcing rings.

These results show that the destruction of insulators by power arcs has been eliminated; that sound insulators protected by arcing rings fail only by direct lightning stroke, and that arcing rings greatly reduce the tendency to puncture by induced potential effects and do not prejudice the effective insulation of the line.

Fig. 2—Protected Insulator on Top Wire.

TRANSMISSION-LINE TROUBLES.

IN view of the rapidly increasing growth of high-tension transmission lines and the consequent interest taken in them by engineers and central-station men throughout the country, some trouble experienced in one state, with a brief description of the line, may not prove amiss.

The transmission line in question runs across a fairly rolling country. The first line constructed was built on the right-of-way of a railroad and consisted of aluminum cables strung on what is known as "A"-frame wooden poles—that is, two poles set at an angle and having a common cross-arm. One insulator is placed on the top of the two poles and the others on the ends of the cross-arm.

The energy transmitted is generated by water-turbines and the design and construction of the power plant were carefully carried out with a view of preventing any possibility of interruption to service. The record of continuity of service during the period covered by this article from the generating station log sheets is an enviable one. The troubles were not "generating," but "transmission" ones.

In the spring of 1907 a company with which the writer was connected began to take electricity from the transmission company and then the troubles began. The reasons leading to the decision to purchase electrical energy were as follows: The existing plant consisted of a lot of old 133-cycle, 1100-volt, single-phase generators about ready for that "electrical hereafter"—the junk dealer. The capacity of the plant was exceeded and it was necessary to build a new plant and put in a different system, as, of course, it was not desirable to enlarge the 133-cycle system. An opposition company was operating a 60-cycle circuit in the city, and so it was essential to put in a modern system if the company was to secure any new business or hold what it already had. At that time the transmission company was building its line within a few miles

of the city, so a contract was made with it for electrical energy. At that time the plan was to use the transmitted energy exclusively and practically abandon the old steam plant, but it was afterward decided to use the old plant as a distributing station and to install a reserve generator which could also be used to take some of the peak load and thereby reduce the rate charged for energy, which was based on a sliding scale depending on the load factor.

The energy transmitted had a frequency of 25 cycles, and, inasmuch as the major portion of the connected load consisted of incandescent lamps, it was deemed advisable to install 60-cycle frequency changers. This, of course, involved changing the entire system throughout the city, while at the same time maintaining service.

Energy was first taken from the transmission line in the early summer and used for motors to which were belted generators supplying energy to the existing city circuits. It was then that trouble began, and for the next two years it never stopped.

Every central-station operator can appreciate what it means and how it feels to have the line dead. But, fortunately, comparatively few have to undergo the torture of mind incident to a failure of supply from outside sources, especially when one realizes his utter inability to do anything to restore the service. If an accident in a generating plant cripples the system the man on the job has at least the satisfaction of going to the seat of trouble and, if necessary, pulling off his coat and helping to repair the difficulty. This, at any rate, affords him a safety valve for his bottled-up feelings. But when one purchases transmitted energy that boon is denied him, and he can only stand around with his hands in his pockets and swear or occupy his time by trying to give diplomatic answers to irate customers.

As stated before, the trouble began as soon as the meter commenced to measure the energy delivered. The interruptions varied from those of momentary duration to others several hours in length. The large majority of them were officially known as "one-half-minute interruptions," a very short time ordinarily, but exceedingly long when the town is in darkness or without service and a great many machines have to be restarted and synchronized.

At first the chief causes of interruptions were the blowing of fuses at the junction of the branch and main lines, the breaking of insulators on the line and occasionally discharges over lightning arresters. At that time the line was equipped with simple horn-type arresters. These were subsequently removed and no protection was provided on the line, reliance being placed in the arresters at the various stations. These were of different types, some being of the low-equivalent, multigap type and others of a combination horn-gap and high-resistance type. The operation of the line was certainly no worse and possibly a little better after the arresters were removed.

About this time a second transmission line, located on the right-of-way purchased outright by the company and consisting of copper wire strung on steel towers, was built and put into operation. The completion of this line, which paralleled the first, was looked forward to and heralded as the remedy for all the ills to which the transmission line was heir. But it proved to be a snare and a delusion. Of course, a duplicate line was somewhat better than one line alone, but it frequently happened that a storm that would put one line out of commission would also seriously affect the other one. The distance between the two parallel lines varied from about four and one-half miles to twenty miles. They were connected at two or three points along the route, so as to permit a defective section to be cut out and still furnish energy to the end of the line.

Quite frequently it was necessary to shut down the line for purposes of inspection and repair, and as far as possible this was done on Sundays and in the early hours of the morning, but even then work of this kind subjected the distributing company to censure.

Other serious troubles were the frequent surges on the line or sudden fluctuations of the voltage, which would be of such magnitude as to throw the synchronous machinery out of step and make it necessary to start the plant again—a matter of three or four minutes' interruption at the very least, as there were several machines.

Elaborate and carefully planned methods were employed to detect and locate trouble when it occurred, but when there are hundreds of miles of line to be taken care of there is an unavoidable time element in the repair work that cannot be overcome by precision instruments or human agents. An instance illustrating this is recalled. Once the circuit-breaker opened and the instruments showed a leakage to ground. Resistance measurements indicated the trouble to within several hundred feet and troublemen were sent to this location. They investigated, but could find no semblance of anything wrong—all the insulators appeared to be intact, and this fact was reported to the chief operator. Measurements were again taken and they showed that the trouble was within the zone previously indicated.

This time a close inspection was made of every insulator and finally the trouble was discovered in a pinhole puncture through an insulator starting in the groove on the top in which the cable lay. The puncture was not visible except on close inspection after having removed the cable. Of course, during all this time the line was dead—a matter of several hours—and the customers were getting along as best they could.

Another instance is vividly recalled of a disastrous interruption of long duration. The local company soon learned that it was absolutely essential to keep fires under the boilers and throughout the major portion of the day kept the reserve engine turning over. It might be here remarked parenthetically that the engineer had so much practice in doing this "stunt" that he could get his engine up to speed and take the load within three-quarters of a minute from the time he noted from the signal lamps that the transmission line was dead. At the time in question it was necessary to make some essential repairs to the main steam header in the plant, which repairs had been postponed from time to time awaiting an opportune moment. Finally one Sunday in July was chosen. The change necessitated drawing the boiler fires and required five or six hours' time. The transmission company was notified and asked to do all possible to make a record for itself, as the city would be absolutely without light or motive power should the transmission circuit fail. Work was started early Sunday morning and the header dismantled. The work was progressing nicely when a storm came up. To make a long story short, the supply went off at 11:15 a. m. and was not re-established until 6:15 p. m., an interruption of seven hours. The work on the steam main was not completed until after 6 o'clock, and the result can be imagined. The feelings of the superintendent on that day can better be imagined than written. It is certain they were not conducive to Christian living and thinking. Frequently one of the fuses in the branch line would blow, resulting in single-phase energy being delivered. This, of course, was equivalent to an interruption, as the motors were too fully loaded to run satisfactorily on single-phase current.

Some of the most vexatious delays occurred during the transition period or when the old system was being changed to conform to the new and no reserve unit was available. These interruptions, of course, occurred at the most inopportune times, usually in the evening about the time of peak load. The street-lighting circuits were fed with this transmitted energy, and, of course, any interruption to them was disastrous from more points of view than one. The city fathers lost no chance to inform the superintendent in terms more explicit than polite just what they thought. One councilman who was defeated for re-election even went so far as to tell him that he (the superintendent) was the cause of his defeat because he had voted to give the company the contract for lighting some years previous.

A glance over the record of interruption, varying in length from one-half minute to eight hours, for a period of nearly two years shows various causes assigned, but the majority of them seem to be lightning storms, repairs to lines and fuses blowing. For a period covering one year there were 120 inter-

ruptions, with a total of over ninety hours. This was not a record for a central-station man to emulate, and quite a contrast to one pointed to with pardonable pride by a superintendent, whose company also purchases some of its energy from this transmission company, who said: "The current has not been off the Edison three-wire busbars for over twenty-two years."

It did not take very much of this service to impress the company with the fact that if it wanted to hold its customers or secure new ones it was essential to proceed immediately to build a new steam plant capable of taking the entire load and using the transmitted energy as the auxiliary. This was done and the company is now doing well, but not until it had learned its lesson through the medium of bitter experience.

CONCERNING AMERICAN WIRELESS ENGINEERING.

By O. C. Roos.*

THE wireless art in America has been ever since its exploitation by the promoter's rule a center of turmoil, with the Patent Office as a flanking column and the "yellow" scientist and half-baked "expert" as strategic centers.

Deadly ambuscades of well-concealed assumptions have made a clean patent victory possible solely by cutting a combination Gordian knot of most routine wireless claims. International commercial jealousy has until lately stifled the efforts of scientists to aid the art to a greater degree of precision by publishing long-known results of practical tests. It would take several millions of dollars to disentangle the logical priority of invention in this art when freed from legal quibbles and adroit technicalities. Strange to say, in no department of electrical testing measurements has America excelled more than in high-frequency work, and yet in no department has there been more general public ignorance in other countries of the results accomplished, commercial distrust being a prime factor here.

In view of the fact that Dr. Seibt in writing about wavemeters in general and his patented wavemeter in particular in the issue of the *Electrical World* of Sept. 29, 1910, has made some invidious comparisons and assumptions, I feel that a little inside history from the American standpoint by one who saw this "new" meter developed and tested will clear the air to some degree.

We undoubtedly owe much to Continental contemporaries, and if the Germans have been painstaking in the finer details of experiment, there is equal credit to be given to the clearness and elegance of French interpretive contributions to the art. Moreover, as shown below, England's mathematical contributions to the art through Thomson, Heaviside and MacDonald have had practical results in America second to none in originality or importance. To America's work on the computation of inductances and capacities, as carried on by Rosa at the Bureau of Standards, has in some cases been paid the flattering compliment of almost verbatim insertion in the "Jahrbuch," and the essential methods used by Stone and the author in treating the linear oscillator before 1905 are but now being employed by advanced European physicists and engineers.

There are undoubtedly those to whom German technical progress in the "wireless" art represents the forefront thereof. A halo of confident superiority to commercial exaggeration of performance has even been ascribed to concerns whose thoroughness in experiment has often been achieved at the expense of fairness in regard to prior rights established in the development of similar principles. Leyden jars have been "stretched" into "inductive couplings" and there has been a general "transmigration of ideas," in some cases almost amounting to a rebirth as far as patent claims are concerned. Though with less bombast than the American promoter indulges in, "business is business" in Germany under a centralized wireless movement just as much as it is over in the States with their "laisser-faire" wireless policy.

As one who has been in intimate contact with the art from its practical beginning in America, I may state that the controversies concerning priority of invention among German investigators have been just as acrimonious as those in the States. In the matter of measurements and analysis of performance they have been more so, and perhaps have thus better disseminated technical progress among German engineers and physicists. Be this as it may, the net results in their effect upon comprehensiveness and accuracy of measurement have never approached until very recently the achievements of certain American wireless organizations.

Among others, there have been two companies never under suspicion of the least connection or even association with stock jobbing, which are unapproached as far as concerns their experience respectively in selection of proper measuring conditions and methods and in making possible and practical what the leading engineers of Europe called a "chimera," the high-frequency alternator. The Stone Telegraph & Telephone Company, of Boston, Mass., and the National Electric Signaling Company, of Washington, D. C., have contributed to the art, if not to the published literature of the subject, in a degree unexcelled anywhere in performance predetermination and long-distance work.

To be more specific it may be noted that in the domain of pure analysis there is a much closer agreement between theory and practice of vertical antenna predetermination using Stone's analysis than Drude's or Mandlestam's. The two latter are based on the theory of the "counterpoise" ground and have to be corrected near and above the fundamental of the vertical by constants or "coefficients of ignorance."

Stone's and Cram's analysis by Heaviside's operational methods (which Stone was the first to use in America) of the mean average inductance of an oscillator was followed by a reconsideration by the writer in 1905 of the problem, taking into consideration as a refinement of analysis the inductance of the displacement currents of the "rational current element." These methods of treatment have been overlooked by European engineers.

There soon followed the predetermination for all frequencies of the American engineering concepts, the resistance equivalent of radiation from a transmitter and re-radiation from a receiver, which may be something considerably different quantitatively.

Antenna reactance at the "driving point" in a transmitter was shown to be a periodic function of the frequency—in fact, sometimes an inductance—as early as 1902, long before it could be quantitatively implied by Continental engineering treatment from the "counterpoise" standpoint. The results of tests covering months during 1903 and 1904 at the Boston Navy Yard showed an average error of less than 1.5 per cent between theoretical uncorrected formulas and practical results.

We may consider then, among others, as unique American contributions to wireless the early performance prediction of radiation and re-radiation, the calculation of the mean average inductance with varying current distribution of a linear oscillator composed of an infinity of "rational current elements," the analysis and engineering use made of the concepts of "selectivity" and its converse, "persistency"; the prediction and verification of commercial wireless circuits with three degrees of freedom, receiving three predicted frequencies simultaneously within 2 per cent. This last work is incorporated in United States patent applications as a mere side issue to the major problem of relieving "static" troubles.

Touching upon the question of refinement of investigation in measurement, I may say that since 1902 a circuit of the "latest type," as stated by Dr. Seibt, has been used by the Stone company, said circuit having the best selectivity and wire spacing to avoid distributed capacity effects; it therefore dates some

*The long interval between the publication of this communication and the appearance of the article upon which it comments is due to the residence of the author in the distant Philippines, where he is attached to the Bureau of Posts as wireless telegraph engineer.

time before the imperfect Tesla, Slaby and Seibt apparatus. In this apparatus the skin effect was kept, for measuring open circuits, well below 10 per cent of the resistance equivalent of radiation or re-radiation, which were themselves measured directly more than seven years ago, before Simon, by Mr. E. R. Cram, the discoverer of the speaking arc. The selectivity or $\sqrt{\frac{L}{R^2C}}$ was kept at the best value for different ranges, thus anticipating Scheller's measuring patents, based on constant L to C ratios. Hence, in 1903, capacities were measured to 1 part in 800 and inductances to less than one part in 1800 at high frequency.

The so-called "impact" and other excitation for testing by means of a buzzer, used both with and without a "weeding-out" circuit as "flywheel" and reservoir and adopted by Austin, Eichorn, M. Wien, Seibt, and others, was known as early as the date of Stone's patent covering the prior use of the so-called "Zwischenkreischaltung" of the Germans.

The operational solution of the reactions in the so-called "Braun" coupling was calculated by Stone and computed in 1902 by a whole corps of assistants, taking into consideration both skin effect and "resistance" of attached antenna. The treatment is, of course, much more exhaustive than anything before or since undertaken. The phase relations, with their sudden critical reversals of sign, are unexampled in interest for their bearing on many recent measuring methods, the recently developed critical methods of measurement used by Fisher and criticised by Makú in the "Jahrbuch" being related thereto.

The above American contributions, among others, are of fundamental importance and have been adapted to measurement with the same certainty in most practical cases that attends the use of Ohm's law, but they unfortunately are only to be found in commercial, engineering and laboratory records, or in the unpublished proceedings of the Society of Wireless Telegraph Engineers; furthermore, the only two public contributions thereon did not, in fact, appear in the technical American press until Oct. 15, 1904, and July 4, 1908. European engineers have the less excuse for ignoring these contributions, as they are admitted to be, as a class, better linguists than Americans, few of whom read the technical literature of foreign countries.

The most striking engineering departure in the points of view of advanced American and European wireless engineers is the fact that the former have for years engineered on the basis of continuous, though unrealized, harmonic waves. These have finally been made possible by Fessenden, Alexanderson and associated engineers in America. Very persistent oscillations gave close results years ago with high selectivity circuits, but the interesting point is the fact that we are now able to do with the certainty of "60-cycle" engineering and with greater quantitative confidence what was prophesied and closely approximated by fundamentally different methods of excitation more than five years ago.

It is the manufacturing weaknesses and lack of a consistent construction policy in the race for cheapness and "fool-proofness," inspired by the growing amateur interests in the States, which have made until recently the American art a chaos.

Direction-finding methods have been more widely experimented with in the States than in Europe, where to-day there are used crossed loop antennas originally intended for asymmetrical "magnetic" oscillators, but now modified to constitute a composite combination of Brown, Blondel and Stone verticals.

The difference between the current distribution of a receiving and transmitting linear oscillator, indicated by Stone in his classic paper on "The Theory of Wireless Telegraphy" before the International Congress at St. Louis in 1904, was solved, in 1907 and 1908 respectively, by the writer and Stone independently.

In regard to the development of the Seibt wavemeter in America, this should be regarded as the result of careful experiments with it in an American laboratory, as it has been made a success solely by following up defects which developed during the writer's use of it in its first trial in practical field work, in Toledo and Cleveland, Ohio, during the summer of 1909. Reports were made indicating improvements and showing the "fatigue" of the crystal detectors employed therein. To-day this type of meter, when fine stranded wire is used with low-resistance inductances, is the best all-around instrument of its kind on the market, though its defects as a "decremeter," implied in Dr. Seibt's article, are still to be reckoned with. It is scarcely an epitome of modern improvements as implied, since the same defects were long ago circumvented by the Stone company, which used the bolometer of Langley and Rubens in a specially sensitive form to get comparative tests in measuring oscillation phenomena. The Gesellschaft für Drahtlose Telegraphie in using the Hartmann Braun H.W.A. was, therefore, not introducing a real innovation in meters for station testing.

This wavemeter problem has become very involved owing to "overlapping" domestic and foreign patents, since Stone first pointed out the dependence of sharpness of tuning on loose coupling and persistency. The practical application of the former has been long patented in the United States and other countries and has been widely copied by concerns who formerly advocated close coupling. One firm formerly advocating its use to the highest possible degree, so as to transform even the upper harmonics from antenna to oscillation circuit, is now using loose coupling.

The work of Stone in analyzing from the engineering standpoint the linear oscillator into an infinite series of Hertz oscillator in 1902 complements the work of Poincaré, MacDonald and Brillouin, not to mention Max Wien, Abraham and Uller ("Jahrbuch," 1909). The latter has adopted and Fleming has quoted as "well known" the above classic contribution of Stone.

The epoch-making monograph of Bjerknes referred to by Dr. Seibt is well known to be limited in scope when decrements are being measured to very loose coupling, a correction, as first shown by Max Wien, always being necessary. Thus we encounter another confirmation of the thoroughness of early American insight into the practical significance of the most elusive factors in wireless measurement. Both in point of time and initiative American workers have more than held their own at least in laboratory testing measurements.

It is indeed high time for American physicists and engineers in the university, shop and factory to unite with responsible societies organized in the interest of wireless engineering for the much-needed publication of an American equivalent to the justly admired "Jahrbuch" of our foreign contemporaries. Commercial jealousies and bad faith in prosecuting research for temporary ends in the past have frequently rendered it inexpedient to publish matter of the most profound interest and value for future unity of effort and progress. Some of the most valuable work ever done has been "buried" since 1902.

In the matter of continuously generated electric waves I would digress for a moment to call attention to the fact that the editorial reference (Sept. 29) to the magnetic forces in a hypothetical electromagnetic wave, "at a standstill" and thus examined, is misleading. A "stopped" wave has no magnetic component—in fact, is a contradiction in terms, all its energy being stored as dielectric flux. To carry out the proposed examination we should have to imitate Lagrange's bird and fly along *with the wave* at the velocity of propagation (light) to observe the magnetic forces in any "phase" therein. Under these circumstances we could witness the phenomena described. Finally, as a means for generating these waves we cannot fail to be struck by the practical development of the high-frequency alternator, the "ignis fatuus" of dozens of well-equipped foreign inventors. The present utilization of high-frequency harmonic ether waves has been made possible solely by the scientific imagination and commercial daring of the engineers associated with the National Electric Signaling Company, of Washington, D. C., under the direction of Prof. R. A. Fessenden, a pioneer and leader in really large wireless engineering undertakings. With the rapid development of this machine,

methods of multiplex, "secret" and "interference-proof" telegraphy and telephony which have been successfully tested in the laboratory by numerous experts will be rendered practical everyday facts—the signals of the wireless promoter's imminent quietus.

ELECTRICITY IN FARMING IN SWEDEN.

During the past several years the use of electricity has been a subject of considerable interest in Sweden, as the increasing cost of labor has been felt particularly by the farmers. At the agricultural institutes at Alnarp and Ultuna and at a number of large farms experiments have been made on the use of electric power for stationary and moving machines and for transportation purposes. The results are stated to be very successful, and installations have been made in several places, especially in the southern part of Sweden.

A strong factor in the awakened interest in Europe in the application of electricity to farming was the International Congress for Motoculture held in Amiens, France, in September, 1909. At this congress an international society, the Fédération Internationale de Motoculture, was organized for introducing mechanical and electrical power and appliances for agricultural purposes. The scope of the society includes the collection and publication of data obtained with experimental and actual installations and service, thus supplying a free information bureau for suggestions or advice in regard to mechanical or electrical applications in farming, and, in general, the encouragement of the use of electrical and mechanical power on the farm. The headquarters of the society are in Paris, and local sections are being established in several European countries. In October, 1910, the first national section was founded in Sweden. The work of the Swedish section will be conducted by the representatives of Sweden at the international congress, Baron Carl C:son Bonde and Dr. J. Tinsberg, of the Ultuna Agricultural Institute. Local independent societies are established in several provinces in Sweden for investigating the demand for electrical energy among farmers and to secure such energy at the lowest rate.

In the Province of Skane the farmers have founded a central-station company for the purpose of building generating stations and furnishing their own farms with electrical energy. In other cases farmers have formed a distribution company, the purpose of which is to buy energy at the central-station switchboard, erect transmission lines and transformer stations and sell energy delivered at the farmers' premises. In such cases the distribution company pays about 2½ cents per kw-hour and sells to the consumer for 5½ cents per kw-hour. If the distribution company is a stock company the stock is usually divided among the stockholders proportionately to the size of the farm in acres of cultivated land owned by each stockholder, or the stock may be divided according to the amount of energy used by the respective farmers.

Experience in Sweden and Germany shows that the average energy consumption is about 15 kw-hours per acre of cultivated area for lighting and various small motors, not including plowing, which requires about 36 kw-hours per acre per year. Considering the case of a farm of 150 acres of cultivated land, the energy consumption would be $15 \times 150 = 2250$ kw-hours per year. With the above assumed prices the earnings for distribution companies from such a farm would be $67.50 per annum. Experience has shown that for a distribution company an annual sale of energy amounting to 10 per cent of the cost of the installation will cover all the expenses and give a fair interest on the capital. Therefore, a farm of 150 acres could profitably invest $675 in a transmission line whether it be in a distribution company or an individual line. Of this amount about one-third will cover the cost of transformers and two-thirds remains for the transmission line proper. The cost of building such a transmission line in Sweden is about $1,000 per mile. That is, a farm of 150 acres can build a transmission line somewhat more than a half-mile long with a good economical result. In case electrical energy is used for plowing a longer line can be erected. However, experiments have shown that plowing is only profitable at a cost of 3 cents per kw-hour for the electrical energy. Such low rates have been obtained in some places in Sweden, or even lower for small consumers, and it is expected that farmers' distribution companies using about 2,000,000 kw-hours will receive such rates from the central stations all over the country. In fact, one of the largest central-station companies offers energy to farmers at 2 cents per kw-hour.

A TYPICAL SMALL CENTRAL STATION.

The Wooster Electric Company, of Wooster, Ohio, operates a small plant which typifies both in its history and in its business the average small central station in the United States. The company was organized in 1885 as the Wooster-Schuyler Electric Company and in 1890 a stock company was formed

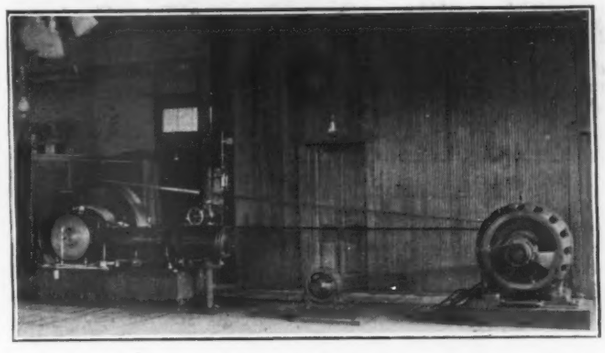


Fig. 1—75-kw Belt-Driven Alternator.

as the Wooster Electric Company, the stock being owned by Wooster people. At the time the plant consisted of one 50-kw Thomson-Houston generator. In 1900 a 75-kw Fort Wayne single-phase generator was installed to replace the Thomson-Houston set, and from time to time small generators were added to take care of additional load as business grew. In November, 1909, a 75-kw Westinghouse alternator was substituted and in March, 1910, a 250-kw Westinghouse alternator was added to the plant.

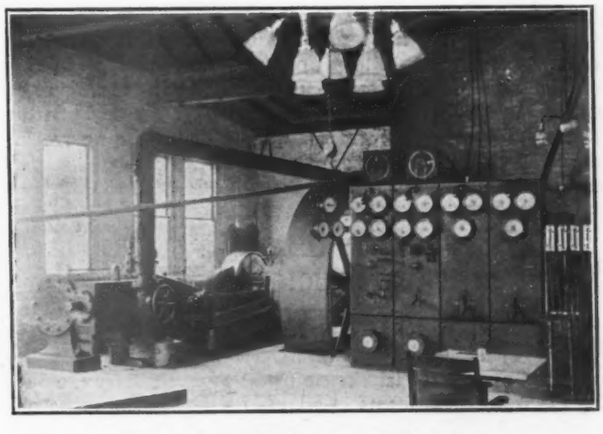


Fig. 2—Large Engine and Switchboard.

Wooster is a college town and does not boast of many manufacturing industries, nevertheless the company has found it profitable to provide a 220-volt motor service in addition to the 110-volt lighting service. The motor load averages about 25 kw during the day and has doubled since the installation of the large generator in the spring of 1910. The load is made up of motors in small machine shops, blacksmith shops, har-

ness shops, bakeries, ice-cream establishments, plumber shops and one garage, and there are a few motors connected to house pumps. The lighting circuit supplies lamps for residences and there is in addition a series circuit for street lighting, direct current being obtained by means of a Cooper Hewitt mercury rectifier. The street circuit consists of ninety-six arcs. The lighting and motor circuits are fed from 2200-volt, three-phase lines. In addition there is a separate line supplying the Wayne County Children's Home, two miles distant, and a line supplying the Wayne County Infirmary, one and one-half miles distant.

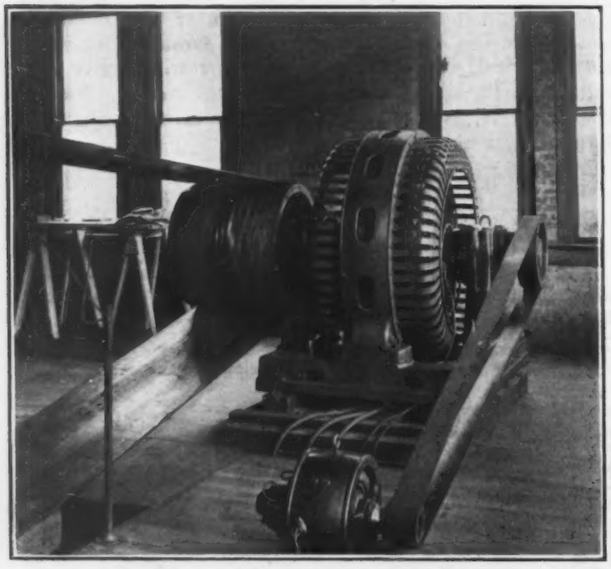


Fig. 3—250-kw Belt-Driven Alternator.

The power-house building is of brick and has a slate roof. The building is divided into an engine-room, two offices and the boiler-room. The boiler plant consists of two 150-hp Russell boilers, hand-fired. City water is used, and the fuel burned is Massillon slack. Steam is carried to the 75-kw set by means of a 4-in. pipe and to the 250-kw set by means of a 6-in. pipe.

The smaller set is a 75-kw, 2400-volt, 900-r.p.m., three-phase, 60-cycle Westinghouse type generator belted to an 80-hp Russell automatic cut-off engine installed on a stone and brick foundation. The foundation of the generator is of framework. The larger set consists of a 200 kva, 2400-volt, 600-r.p.m., three-phase, 60-cycle generator of the same type as the smaller unit. It is belted to a 250-hp Buckeye engine with automatic cut-off. The engine foundation is of stone and the generator foundation is of wood on brick set in cement. Both engines use steam at 100-lb. pressure.

The wiring between the generators and the switchboard is all concealed under the flooring. The four-panel switchboard contains two generators and two feeder panels, as can be seen in the photograph. The alternating-current voltmeters and a synchroscope are mounted on a frame bracket at one end of the board. An ammeter is provided in each leg of each circuit and the field rheostats are mounted above the top of the board. All circuits entering the building are protected by Westinghouse lightning arresters. The 75-kw machine is used to carry the day load and the 250-kw machine for the night load. During the heavy winter load both the machines are sometimes required.

Central Station
Management, Policies and Commercial Methods

UPKEEP COSTS OF ELECTRIC PLEASURE VEHICLES.

Records obtained by the Rauch & Lang Company, Cleveland, Ohio, from twenty owners of its electric pleasure cars, these having been in use for various periods, show that the twenty cars sustained $2,687 battery, tire and adjustment expense during last year. This represents an average yearly expenditure of $134.35 per car, or $11.19 per month, or $0.37 per day. At the basis of thirty miles travel per car per day, these figures indicate an upkeep cost of 1.2 cents per mile, to which, of course, must be added the cost of energy.

CENTRAL-STATION EXPERT TO INSTRUCT ELECTRIC TRUCK OPERATORS.

The Cleveland Electric Illuminating Company has secured the services of an expert electric vehicle man to supervise the operation of commercial electric trucks using its service, assisting the regular attendants in getting the best performance out of the trucks. The services of this man are furnished free to the electric truck customers of the central station, in the case of the larger truck garages the expert spending a few days or a week in each place explaining the proper operation of the truck mechanism and the charging and care of storage batteries. While this plan of technical assistance has been only recently carried out, truck customers are already showing their appreciation and satisfaction with the new arrangement, which will be conducive to even more successful operation of the electric trucks already in use in Cleveland.

NATURAL-ICE SHORTAGE INCREASES ACTIVITY IN ARTIFICIAL PRODUCT.

From all parts of the country there come reports that the winter season has been a poor one for harvesting natural ice and that the natural crop will be correspondingly small next summer. Ice is usually cut in January and February, but among the peculiarities of the season now coming to a close were cold snaps in December, while January and February were comparatively mild. This unusual condition was in no sense local, but seems to have been widespread over the United States, and ice dealers report that it will be possible to fill few ice houses during the short period of freezing weather yet possible in some sections. A number of natural-ice storage companies have sent in hurry-up orders to manufacturers of artificial-ice machinery for apparatus with which to supplement their supply for next season's demand, and among these several combination ice and electric plants are also reported. For the electric company contemplating going into the combination-plant field in competition with local naturally frozen ice, the present season thus seems a specially timely one in which to make the start, and in view of the exceedingly profitable reports made by companies already operating ice-making auxiliaries, as reviewed in the *Electrical World* of March 2, the opportunity ought to be carefully considered. The experience of other companies has already shown that clean, pure, sanitary artificial ice commands an increasing market for itself in a way that is denied the natural product. In towns where the 1911 natural supply is limited, as above reported, central-station ice plants will enjoy a marked advantage for all time by getting under way the present season.

RATES IN ONTARIO, CAL.

At a meeting of the City Council of Ontario, Cal., on March 7 that body authorized the city attorney to draw an ordinance lowering the primary rate for electric lighting from 13 cents to 11 cents a kw-hour, with 10 per cent discount for prompt payment. The proposition came as a complete surprise to the Ontario Power Company, which had no time to present its side of the case. At the end of three hours' debate action was deferred until the company could present figures in defense. Representatives of the company say that the new rate would be very unfair, as the city is scattered over a large extent of territory, extensions being expensive and interest charges on transmission and distributing equipment high.

NEW BRANCH OFFICE OF THE NEW YORK EDISON COMPANY.

Largest and most notable among the new branch offices of the New York Edison Company is the one at 424 Broadway, just above Canal Street, which is rapidly gaining a place of prominence in the business life of the downtown section. It

Broadway Office of New York Edison Company.

was opened as an office for the first district, also as a display-room for lighting and heating appliances, for which purpose it is admirably adapted.

Among the features which have gained for it special notice is its establishment of a precedent in that part of the town in night lighting. In the dark and dismal appearance that the business section presents at night the office stands out as an oasis of light. The office is lighted by sample fixtures of various types and sizes for display purposes. Both tungsten and arc lamps are used, the arc being the most general type.

In the window, the upper part of which consists of stained glass showing several famous "Edison People," by Cooper, are displayed handsome lighting fixtures and household appliances. This window is lighted by sixty-three 150-watt tungsten lamps with concentrating prismatic glass reflectors. The initial candle-power in this window is 7560, while the downward candle-power, increased many times by the reflectors, is approximately 37,800.

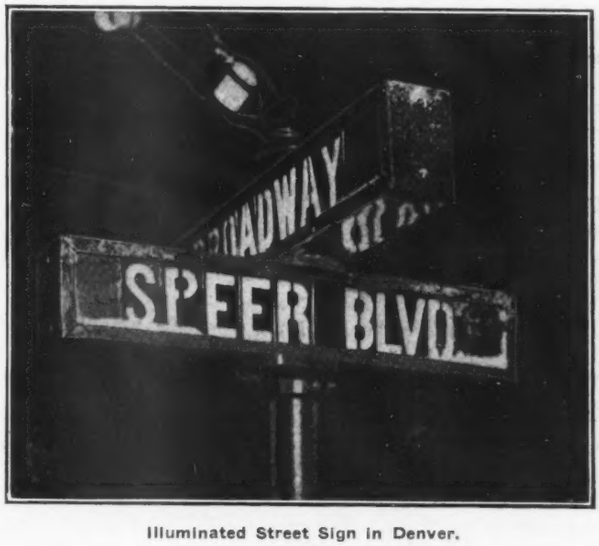
The main part of the office is very efficiently illuminated by arc lamps and tungsten lamps used with the Alba distributing ball. There are also different types and sizes of tungsten lamps being used with two-lamp and six-lamp fixtures. When totally lighted the office has an average of from 7 ft.-candles to 10 ft.-candles. The new 400-watt and 500-watt tungsten lamps used with large specially designed opal diffusing balls are also on exhibition.

There is a total of 4224 sq. ft. of open floor space in the new office, the front part of which is used for the showroom exhibits, while clerical departments do their work in the rear. So great, however, has been the expansion of Edison work that it has already become necessary to secure the second floor of this building, with approximately 4000 additional square feet of floor space. The intention is to move certain departments upstairs as soon as the necessary alterations can be completed and devote the greater part of the first floor to exhibition purposes. This floor is now occupied, in addition to the first district office, by the bureau of unused meters and apartment house statistics and by the editorial staff of the company, which will take the second floor when it is ready for use.

It is the intention of the New York Edison Company to make this branch office a display and demonstration room for all kinds of electrical apparatus which could be used by business and manufacturing concerns in that locality. The basement will be utilized for demonstrating heavier types of machinery, so that a prospective user of motor drive can see it in actual operation as applied to almost any kind of machinery. The showroom on the first floor, which now contains a very complete exhibit of household devices, such as vacuum cleaners, irons and all manner of heating and cooking devices, will be made to include everything for use in a business office. Among other things demonstrated will be the dictograph, adding machine, desk lamps, etc. At this office there is now a complete electric refrigerating plant in operation. Although household devices are not used in that locality, the object of displaying them here is to give the business man, who rarely gets an opportunity to take time to visit a department store, a chance to see electrical devices which will facilitate the household duties in his own home.

ILLUMINATED STREET SIGNS.

Denver is a progressive city in many ways, and one of the manifestations of its effort to keep abreast of modern improvements is shown in the matter of street signs. Ornamental bronze signs are used on Fifteenth, Sixteenth and Seventeenth Streets, and iron-pole signs with white-enameled letters in the residence districts. A new type of sign for street intersections is designed to be illuminated and is illustrated herewith. But one of these signs has been built, and it is placed at Speer Boulevard and Broadway. The sign was designed by Captain Phillips, of the highway department, who has applied for a patent for it. A concealed 8-cp incandescent lamp is used to



Illuminated Street Sign in Denver.

illuminate both arms of the sign at night. The light is reflected to the sign from the interior, the letters being on a background of mica. The lamp is so arranged that it cannot be disturbed by

mischief makers, but can be removed for cleaning or renewal. The standard consists of iron piping, the signs being 7 ft. or 8 ft. from the ground. The present sign is an experiment. If adopted the signs will be placed only at prominent corners away from the brightly lighted central district and at street-railway transfer points. The cost of manufacture is but little more than that of the regular iron-standard sign, and the cost of wiring to near-by distribution wires is not large. The expense for the consumption of electricity would be slight, of course, and the light could be turned on and off from a central point.

SECURING A SUMMER MOTOR LOAD IN A LARGE MANSION.

The increasing tendency of men of great wealth to build large and costly country seats in rural, mountainous or seaside districts presents an interesting problem in electrical supply to the central-station organizations serving the territory. In some parts of the country a highly desirable summer business in both lighting and motor-service fields has been developed in connection with the yearly visits of prosperous cottagers. This class of customers is used to the best service and equipment of the urban companies. The persons composing it are appreciative, as a rule, of painstaking efforts to carry city comforts to their summer homes, and are generally willing to pay a liberal price for the facilities supplied. In the case of very large and elaborate country seats first cost is often a matter of little importance. The owner desires the best that money can buy, and consequently is frequently led into the purchase of all sorts of apparatus designed to promote the comfort of himself and his family. It frequently happens that the cost of operating such equipment is great, even for a part of the year, and there exists in not a few cases an excellent opportunity for the central station to undertake the supply of electricity with the prospect of making a substantial saving in annual cost and at the same time vastly improving the quality of the service rendered.

A representative instance of this character has recently come under notice through the courtesy of the motor-service department of a prominent central station. As a result of the investigation made in this case electrical service has been installed in place of steam-plant production on the estate. The estate is a very large one, there being a total connected load of 79 hp in motors and 2200 16-cp lamp equivalents. An extensive system of water supply is in service and electricity is used in the operation of pumps for elevator and greenhouse service, refrigeration, the handling of trunks in an underground tramway tube, dairy, repair shop and barn service. Other motor applications are concerned with the improvement of the house-heating service and the operation of laundry machinery. There are eleven motors on the premises, and in addition to the water service compressed air is used on the estate for various purposes.

Two artesian wells supply all the water used on the estate. One well is located in the base of a tower and the other in the greenhouse. In the top of the tower is a storage tank having a capacity of 50,000 gal. At the foot of the tower are located a high-pressure boiler, machine shop, steam pump and steam-driven air compressor. Air and water-pipe lines extend from the tower to the greenhouse. From the base of the tower to the mansion, 700 ft., a tunnel 6 ft. square is installed for the carriage of trunks, provisions and servants, and this tunnel is equipped with a car driven by a 5-hp motor. The air compressor delivers to a 2-in. pipe that extends to the greenhouse well. About 110 gal. of water is raised per minute and discharged into an open tank. An ordinary steam pump driven by compressed air forces water from the greenhouse tank into an open tank in the base of the tower, the lift being about 32 ft. About 30 gal. per minute is lifted by compressed air from the artesian well at the base of the tower and discharged into the open tank at the base of the tower. From here a steam pump elevates the water 78 ft. into a tank at the top of the tower. In the winter season the demand for water is comparatively small, even through a six-month period, and in the cold season the average consumption is about 3000 gal. per day. During the remaining six months the consumption averages about 15,000 gal. per day. This water is used for sprinkling lawns and gardens, and at times 100,000 gal. would be used were that amount of water available. The mansion is ordinarily closed for three months in the winter.

The mansion is equipped with about 1000 incandescent lamps, there being 514 in a boathouse on the premises and enough in other buildings to make about 2200 lamps of 16-cp equivalent. About 300 kw-hours are consumed monthly in the mansion and premises.

The motor load is analyzed as follows:

Mansion heating-system fan, 5-hp motor; not used in summer; used in the winter four months, 500 hours per month, at 4-kw load, or 8000 kw-hours total.

Mansion elevator pump, 3-hp motor; plunger, 6-in. diameter; two stories, 32 ft.; 47 gal. per trip and twenty trips per day. Consumption, 940 gal. of water per day, equivalent to one-half hour continuous running and calling for 1.2 kw-hours per day. The summer requirements are 36 kw-hours per month, or 216 kw-hours total; and the winter requirements are 18 kw-hours per month, or 108 kw-hours total.

Mansion refrigerating plant, 3-hp motor. In the summer the load is 1.8 kw for twenty-four hours per day, thirty days per month, or 1296 kw-hours per month, or 7776 kw-hours during the season. In the winter 0.9 kw is required twenty-four hours per day, the total energy for the season being 3888 kw-hours.

Tunnel tramway, 5-hp motor; the consumption is so intermittent as to be practically negligible.

Tower repair shop, 3-hp motor; 1.2 kw is required about twenty-five hours per month, say, 360 kw-hours per year.

Dairy, 2-hp motor; runs separator, milker, freezer and churn; 1 kw is required fifteen hours per day or 540 kw-hours per year.

Barn, 5-hp. motor; runs feed cutter and mill; 4 kw is required twelve and one-half hours per month, or 600 kw-hours per year.

Greenhouse pump, 3-hp motor; head, 32 ft.; 110 gal. per minute through 1700-ft., 4-in. pipe; friction head, 8 ft.; total equivalent head, 40 ft. Required, 2.2 kw for two and one-half hours per day, or 5.5 kw-hours. This pumps 15,000 gal. against a head of 40 ft. Summer operation, 165 kw-hours per month, or 990 kw-hours for season; winter operation, 33 kw-hours per month, or 198 kw-hours for season.

Laundry, 10-hp motor; consumption of energy thus far negligible, as the load is very intermittent.

Tower pump, 5 hp motor; head, 78 ft; 140 gal. per minute; power required, 4.6 hp with 60 per cent pump efficiency; 4.1 kw. Operation, one and four-fifth hours per day for 15,000 gal.; 7.3 kw-hours per day, or 219 kw-hours per month. Summer service, 1314 kw-hours; winter service, 263 kw-hours.

	Max. Demand in Kilowatts.
Mansio heating	4.0
Mansion elevator	2.4
Mansion refrigeration	2.4
Tunnel tramway	4.0
Tower repair shop	1.2
Dairy	2.0
Barn	4.5
Laundry	7.0
Greenhouse pump	2.4
Tower pump	4.1
Air compressor	37.0
Lighting load maximum	55.0
Total maximum demands (sum of all)	126.0
PRIVATE PLANT COSTS.	
Two 50-kw engine-generator sets, installed	$5,000
One 150-hp boiler (extra)	2,000
Total	$7,000

Air compressor, 40-hp motor; pressure at greenhouse, 80 lb.; at tower, 90 lb.; service, 110 gal. per minute with 80 lb. pressure. Required, about 1.5 cu. ft. of air per gallon per minute.

Total consumption, 165 cu. ft. per minute. Drop in air pressure, in 1700-ft. 2-in. pipe, about 4 lb. Total air required, 140 gal. × 1.5, or 210 cu. ft. per minute. About 0.2 hp required per cubic foot per minute, or 42 brake horse-power, say, 37 kw. This service lasts about one and four-fifth hours per day, and thus calls for 67 kw-hours per day. Summer service, 12,060 kw-hours; winter consumption, 2412 kw-hours.

The maximum demands of the above meters are given in the table on the preceding page.

Summer Coal Consumption.—4150 kw-hours per month, or 5.75 kw average load at bus; generator efficiency, 40 per cent, requiring 14.3-kw input, or 29 brake horse-power. Engine runs at 39 per cent normal load and consumes 56 lb. steam per brake hp-hour. Coal consumption, 7 lb. per brake hp-hour. The plant therefore consumes 203 lb. of coal per hour and in the summer 73 tons per month, or 438 tons for the six months.

Winter Coal Consumption.—2903 kw-hours per month, or 4 kw average load at the switchboard. With a generator efficiency of 35 per cent an input of 11.4 kw, or about 15.2 brake horse-power, is required. The load on the engine averages 20.3 per cent of normal and takes 70 lb. of steam per brake hp-hour. With a coal consumption of 8.75 lb. coal per brake hp-hour the coal consumption of the plant in winter averages 133 lb. per hour, 47.7 tons per month, or 286 tons for the winter season as a whole.

The total coal consumption for the year is about 724 tons.

At $4.75 per ton the fuel cost is about $3,440 per year.

A summary of the cost of isolated plant operation per year, including fixed charges, is as follows:

Interest and depreciation @ 10 per cent	$700
Repairs and renewals @ 5 per cent	350
Fuel	3,440
Oil, waste, etc	100
Labor, two men @ $900 each	1,800
Total	$6,390

The cost of handling the service of the plant on central-station circuits was figured as follows:

Summer Load.—3851 kw-hours per month for motor service at 3.8 cents per kw-hour, $146.54; 300 kw-hours per month for lighting at 11.4 cents per kw-hour, $34.20; the total for the six months being $1,084.44.

Winter Load.—2603 kw-hours per month for motor service at 4.2 cents per kw-hour, $109.33; 300 kw-hours per month for lighting at 11.4 cents per kw-hour, $34.20; the total for the six months being $861.18.

The total yearly cost of electricity, including free lamp renewals, $1,945.62, making a yearly saving of $4,444.38 in favor of central-station service.

Wiring and Illumination

THE LIGHTING OF A SMALL ROOM.

In a paper presented before the Chicago Section of the Illuminating Engineering Society on March 16 Mr. James R. Cravath described in detail certain comparative tests of illuminating equipments conducted in a living-room 16.5 ft. long, 12.0 ft. wide and 8.5 ft. high. The color of the ceiling is very light cream; the walls are covered with light-green rough paper. Red portières were placed over the door spaces and green window shades were drawn down over the windows during the tests. In the geometrical center of the ceiling was placed a single lighting unit provided during all tests with a 160-watt tungsten lamp operated at 78.9 mean horizontal candle-power, equivalent to 773 lumens.

Observations of the illumination obtained over a plane 3.5 ft. above the floor were made with the lamp variously equipped, with the results shown in the accompanying table.

Lighting Equipment.	Minimum Foot-Candles.	Average Foot-Candles.	Lumens Effective per 100 Lumens Generated.
Bare lamp	0.698	1.597	40.9
Prismatic reflector, extensive, at ceiling	0.514	2.030	52.0
Opal reflector at ceiling	0.492	2.070	53.0
Indirect lighting, mirror reflector, below lamp	0.422	1.151	29.5
Semi-indirect, opal reflector, pointed upward	0.508	1.470	37.6
Roughened stalactite reflector at the ceiling	0.673	1.390	35.6
Opal bill, 8 inches, at ceiling	0.528	1.310	33.7

The author expressed the opinion that the semi-indirect system with opal reflector is far preferable to the opal ball arrangement, because it is not only easier on the eyes, but more efficient. He said that the semi-indirect system occupies a place midway between the direct system using opal reflectors and the indirect with opaque reflectors; it is not as comfortable as the indirect, and it causes more pronounced shadow, but it is more efficient and does not hide the source of light entirely where some light is wanted for decorative effects.

The author concluded from the tests that the ratio of measured efficiency between a direct system using efficient translucent reflectors and an efficient indirect system in a room of the kind used is as the ratio of 3 to 5. What the practical working efficiency or "efficacy" of the two systems is for different purposes depends on the particular conditions and uses of the room. The tests indicate that the measured efficiency of a direct system using inclosing globes is a little higher than an indirect system with opaque reflectors, although lower than a semi-indirect system with translucent reflectors.

Tests were also made to determine the effect of shadows thrown by an 8-in. disk placed 15 in. from the test plate between this plate and the light source. The shadow reduced the illumination on the test plate by 86 per cent when the opal reflector was used at the ceiling; 50 per cent with the indirect lighting arangement with mirror reflector, and 61 per cent with the semi-indirect system with opal reflector pointed upward. Although there was a pronounced shadow with the indirect system, yet the shadow was less objectionable than with the direct system, by reason of the lesser contrast between the illumination in the shadow and the surrounding illumination.

Discussion.

Mr. George H. Stickney, of Schenectady, remarked that the question arises as to what use is to be made of the lighting in the room being studied. The tendency in illuminating engineering, as elsewhere, is to run to extremes. When the tungsten lamp was brought out much attention was paid to the efficiency of lighting units and this led to too great intensity of light, in many cases resulting in glare. At present engineers, while not sacrificing too much efficiency, are going back to some extent in the direction of providing greater diffusion of light. In household lighting an important question to be considered is how the illumination impresses the women of the household. Mr. Stickney said that perhaps the pleasantest example of illumination is found when a group of people is clustered around an open fireplace containing a wood fire. The unsteady, fitful lighting thus provided transgresses all laws of illuminating engineering, but it conveys an idea of comfort, of cheer, that it would be difficult to obtain in any other way. What is wanted in electric lighting for the household is to make it more homelike. The efficiency is perhaps secondary to securing a pleasing effect, for lighting may be manipulated in many ways to cause pleasurable sensations.

Mr. T. H. Aldrich expressed the opinion that the light of tungsten lamps is too strong and white to be used for household illumination, unless obstructed by colored shades. He is now using indirect lighting, which has many points in its favor; it is good to read by, but it is difficult to design fixtures for

this method of lighting suitable for small rooms which will be artistic in appearance. For decorative purposes perhaps the semi-indirect system is preferable. For desk or table lamps he prefers tantalum to tungsten filaments, as the color of the light is less trying on the eyes.

Mr. A. J. Sweet commented on the differences in the uniformity of lighting and said that greater uniformity with the reflectors would have been obtained with a higher room. He believes the time will come when lighting effects will be used in interior decoration in a manner comparable to pictures made by artists. The strongest light should be on the points of most artistic importance. If a table is in the center of a room, light should be strongest on it; the sense of artistic proportion should be preserved in the lighting effects.

Dr. M. G. Lloyd commented on the relation of variation and efficiency of illumination. Apparent superiority in efficiency is not always real, owing to the variation in the intensity of illumination. The minimum is one of the determining factors. He concluded from the test results that the semi-indirect and direct are the best.

Mr. George C. Keech remarked that the habits of a family group have much to do with the illumination that should be supplied in the room. For instance, where there are school children who cluster about a central table in a living-room the lighting should not be the same as in the case where tables, couches and musical instruments are at the sides of the room and are in almost nightly use.

Mr. Cravath said that for reading purposes the straight indirect system is the best of the systems tested, although the semi-indirect system is nearly as good.

ORNAMENTAL EXTERIOR LIGHTING ON FEDERAL BUILDING, CHICAGO.

To illuminate the entrances and corners of the Federal Building, which occupies the block bounded by Adams, Dearborn, Jackson and Clark Streets in Chicago, a number of ornamental lamp standards have been mounted on granite pedestals which form a part of the building and were provided for that purpose. Two of these lamp standards are placed at each entrance, one on each side of it, and there are now two at each corner of the building, although it is proposed to add two more to each corner. There are thus sixteen standards in all at the present time. Each one is made of cast iron and stands about 8 ft. 6 in. high, weighing about 1600 lb. The posts are painted in rustless black, and were made by the Flour City Ornamental Iron Works, of Minneapolis. Each one supports a single spherical globe of white fish-scale glass about 26 in. in diameter. Mounted in this globe is a 500-watt Buckeye tungsten lamp inserted in one of the new type General Electric sockets made for lamps of this character. The glass globes are provided with hinged doors so that access may be had to the interior to clean or renew the lamp. The lamps are operated in multiple on 115-volt direct-current circuits, electrical energy being supplied by the Commonwealth Edison Company, which furnishes all of the electricity used in the Federal Building.

Lamp Standards at Corner of Federal Building.

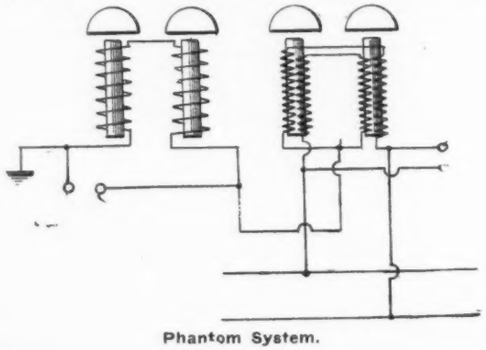
RECENT TELEPHONE PATENTS.

SELECTIVE APPARATUS.

A selective signaling system has recently been patented by Mr. E. Garretson, of Buffalo, which depends upon a changeable resistance member made of material having a negative temperature-resistance coefficient. As long as the impressed potential is such that the resulting current does not generate heat faster than it can be radiated the resistance remains fairly constant. With a heavier voltage the resultant current heats the resistance. This resistance lowers until a balance of heat generation and radiation occurs at a considerable current. It will thus be seen that here is a method of selection based upon difference of impressed voltage. A filament of argentite is suggested for the resistance.

PHANTOM SYSTEM.

A system designed for the dual use of lines, first as a metallic circuit and secondly as a phantom, both line wires being used in parallel with a grounded return, has been patented by Mr. O. M. Leich, of Genoa, Ill. His patent is assigned to the Cracroft-Leich Electric Company. The ringer at each station is wound with four coils, two upon each core. These are connected in series and bridged across the line, the arrangement being such as to give a balanced system with a neutral point available for connection of the auxiliary set. The accompanying illustration shows the arrangement clearly. The system is suitable for dispatch systems.



Phantom System.

CIRCUIT SYSTEMS.

Mr. F. W. Dunbar, of Chicago, has just had issued to him a patent for a modification of his well-known two-wire multiple system for which the application has been pending some ten years. The original system contemplated the winding of the "cut-off-cut-on" relay as bridged between the jack springs. The system of this patent bridges the relay from one spring to ground or a common return. This patent is assigned to the Kellogg Company.

A trunk, as for use between a private branch exchange and the central office, or between two central offices, forms the subject of a patent granted to Mr. J. G. Mitchell, of Cleveland, and assigned to the Worth Electric Company.

One exchange is signaled by a ring from the second, while the latter is signaled by the insertion of a plug at the first. To this end an open repeating coil at the outer end of the trunk is closed through auxiliary contacts in the trunk jack, in case a plug be inserted. Again, for the outward signal, a relay bridged in series with a condenser responds to the alternating current and becomes locked until the locking circuit is broken by the response at the trunk jack.

A patent granted to Mr. R. H. Manson describes an intercommunicating system with facilities for exchange connections.

Each station is provided with a bank of switching keys and with wires to every other station. Facilities are thus provided for intercommunication and in addition for receiving exchange calls at one station and for transferring them to any other one. The holding circuit for the exchange line is automatic, or self-releasing, upon the response of the second or desired station. The patent has been assigned to the Dean Electric Company.

AUXILIARY DEVICES.

In the strife for hygienic conditions small paper drinking cups have been introduced which may be thrown away after one use. The mouthpiece for transmitters patented by Mr. J. Graham, of Philadelphia, is along this same line. A sheet-metal holder is substituted for the hard-rubber mouthpiece of the transmitter and each user may take a paper mouthpiece from the rack and insert it in the holder. The holder has burrs to retain it in position. The stock of mouthpieces is formed into a nest, which nest is supported upon a rack.

An antiseptic mouthpiece has been patented by Messrs. W. M. English, L. E. Boukofsky and S. M. Lichtenstein, all of San Francisco. A metallic nipple is inserted between the mouthpiece and the transmitter casing. One end fits the transmitter and the other fits the mouthpiece. At the mouthpiece end the walls of the nipple are thickened so that a groove may be cut into and concealed within the wall, which groove is of size to carry considerable fibrous material. This is soaked with antiseptic solution and held in place by screwing home the mouthpiece.

Mr. E. O. Lancaster, of London, Ontario, has patented a receiver holder. This is in the form of lazy-tongs with upper and lower members geared together. The receiver is carried upon an adjustable clamp. A link attached to one of the members of the lazy-tongs is also attached to the hook switch and serves to depress the hook when the tongs are shut up and the receiver back out of use.

AUTOMATIC SELECTOR.

A step-by-step device for selecting a special station upon a line forms the subject of the patent obtained by Mr. R. R. Hobbs, of Louisville, Ky. A polarized magnet when energized in one direction serves to step forward a selector wheel. An adjustable pin in this wheel is set to correspond to the angular displacement corresponding to the station number. A reverse current over the line serves to permit the wheel to return to zero.

LETTER TO THE EDITOR.

Vector Notation.

To the Editor of Electrical World:

SIR:—It is regrettable that two different representations of alternating vectors exist, of which the one appears like the mirror image of the other. The difficulty extends to the symbolic representation of the vectors, as in the one, the time diagram, inductive impedance is represented by $Z = r - jx$, and in the other, the crank diagram, by $Z = r + jx$.

It would be very desirable to reach an agreement on vector notation, but this does not seem feasible owing to the apparent impossibility of getting an intelligent decision on the subject, for many of the men who discuss the subject and write on it are familiar with one representation only and never have taken the trouble to understand the other representation, but, since it appears like the image of the notation familiar to them, merely assume it to be rotation in opposite direction and then, Don Quixote-like, attack a creation of their imagination. All the briefs written on the matter do not seem to change the condition, since they do not seem to be read. It appears hardly fair and reasonable to accept the judgment of somebody on a subject which he has not taken the trouble to understand.

An illustration hereof is the title of the Institute discussion "On Vector Rotation," though it is not a question of rotation at all, as both methods rotate in the same direction, counter-clockwise, but a question of *notation*—that is, of the meaning of the vector. A still better illustration is afforded by the editorial in the issue of the *Electrical World* of Feb. 23. Apparently the writer of the latter is familiar with the crank diagram, in which the vector rotates counter-clockwise and the instantaneous values are the projections of the vector on the horizontal line, and he assumes that the time diagram is merely a vector rotation in opposite direction, but does not

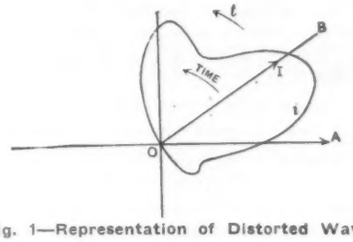


Fig. 1—Representation of Distorted Wave.

realize that in the time diagram the vector does not rotate at all, but is stationary, representing the phase of the polar curve, and the instantaneous values are the intercepts by the rotating time angle.

If the difference in the two representations were merely the difference in the direction of rotation, the symbolic representation would be the same. Since $+j$ mathematically represents an angle 90 deg. behind $+1$, $+j$ in the crank diagram represents a vector which is 90 deg. ahead in rotation, or leading the vector $+1$, regardless of whether the direction of rotation is counter-clockwise or clockwise, and in the time diagram $+j$ represents a vector of a phase which is 90 deg. later in time than $+1$; that is, lags by 90 deg., regardless, again, whether the rotation is clockwise or counter-clockwise. The mere fact that the symbolic denotations of the two representations are different will make it evident to anybody who will spend a few minutes to understand their meaning that the difference is not a mere difference in the direction of rotation, but a difference in the meaning of the vector.

In my opinion, the question is whether we should have one vector representation or two different forms of vector representations. Both the crank diagram and the time diagram represent sine waves about equally well. The crank diagram, however, is limited to the representation of sine waves, while the time diagram, which is nothing but the standard system of polar co-ordinates of analytic geometry, can also represent complex waves and even non-periodic phenomena as they exist in alternating-current circuits as electrical transients. As long as the electrical engineer shall have to deal with distorted waves and with electrical transients, in their graphic representations the polar co-ordinates—that is, the time diagram—will of necessity

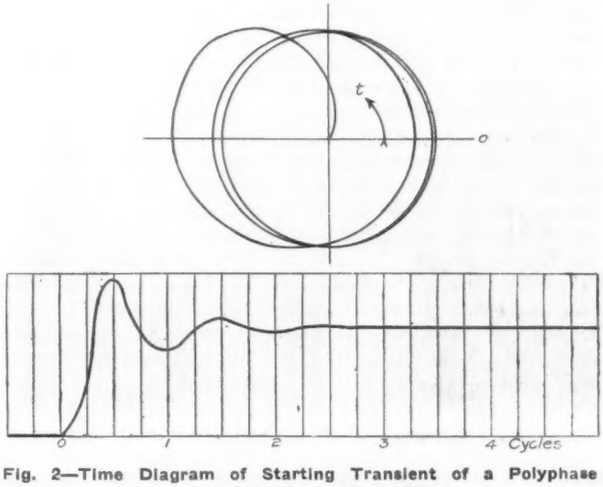


Fig. 2—Time Diagram of Starting Transient of a Polyphase Rotating Magnetic Field.

be used, and the question thus is whether the same diagram should also be used for sine waves or whether in the crank diagram the students shall be made to learn a second form of representation.

An illustration of the representation of a distorted wave by the time diagram is shown in Fig. 5 of my discussion of "Vector Power in Alternating-Current Circuits" in the November, 1910, *Proceedings* of the A. I. E. E., which cut is given herewith as Fig. 1. The polar curve shows five extrema (maxima and minima) and thereby the preponderance of the fifth harmonic.

As an illustration of the time representation of a non-periodic phenomenon in an alternating-current circuit the time diagram of the starting transient of a polyphase rotating magnetic field is given in Fig. 2 in vector and rectangular co-ordinates.

Schenectady, N. Y. CHARLES P. STEINMETZ.

Digest of Current Electrical Literature

ABSTRACT OF THE IMPORTANT ARTICLES APPEARING IN THE ELECTRICAL PERIODICAL PRESS OF THE WORLD

Generators, Motors and Transformers.

Chemical Action in Windings of High-Voltage Machines.—An account of the discussion which followed the reading of the paper by A. P. M. Fleming and R. Johnson abstracted in the Digest last week. C. J. Beaver said that cotton yarn or fabrics which are impregnated with a varnish made by dissolving, say, asphaltum in a suitable solvent withstand the effects of heat much better than do similar yarns or fabrics impregnated with the same compound in a molten state. This is probably due to the individual fibers being better impregnated in the former than in the latter case. In view of these considerations it appears better to use varnish and varnished fabrics and to keep the maximum stress within proper limits. W. Cramp emphasized that even with the silent discharge a certain amount of nitrogen oxides is produced and that the production of ozone alone does not account for all the effects observed. H. D. Symonds said in regard to the use of a metal sheath around the outside of the conductor and insulation that this is obviously difficult to accomplish, but he had made up a series of coils in which the varnished cotton covering of the conductors and the inside and outside of the insulating tubes were coated with aluminum powder such as is used in aluminum paint. The coils had been run at 6600 volts and the average life was greatly increased by the application of the aluminum. Furthermore, there was no destruction of the insulation or other corrosion and analysis showed no signs of the presence of nitric acid. In high-speed machines where ventilation is likely to be at all violent the aluminum powder might be objectionable, but a careful method of applying it might overcome the difficulty. J. S. Highfield believed that a pressure of 10,000 volts to earth is the maximum at which it is commercially sound to wind high-tension alternators, and then only when of large size. For machines of 3000 kw and under the maximum pressure to earth should not exceed 5000 volts. In the long run it is cheaper to wind alternators for a low pressure and use step-up transformers. In their reply the authors referred to the suggested use of aluminum paint; if this were to be effective it would, of course, be necessary to apply it, not to the surface of the group conductors, but to the outer surface of the air-gap—that is, inside the insulating tube or wrap—and contact made between this and one of the turns of the core. The risks of sparking or heating due to imperfect conductivity would be a serious objection to the use of a conducting paint. Regarding the maximum voltage to earth for which machines could be wound, this depends upon two factors, namely, that the conductors should be of such a number and size that a coil of sound construction free from internal weaknesses could be obtained and, further, that sufficient radial thickness of insulation could be used. For machines under about 1000 kw Highfield's figure of 2000 volts to earth as a maximum limit is probably right. The authors expressed the opinion that for larger sizes it would be possible to push the voltage much higher without incurring risks due to chemical action.—Lond. *Electrician,* March 3.

Single-Phase Induction Motor.—K. KRUG.—A mathematical paper illustrated by diagrams in which by analysis using the symbolic method with complex quantities the circular diagram of the single-phase induction motor is developed and the conditions are established under which the circular diagram for the polyphase induction motor can be applied, also for the single-phase induction motor.—*Elek. u. Masch.* (Vienna), Feb. 19.

Lamps and Lighting.

Low Voltage for Direct-Current Lamps.—An article pointing out the advantages of low-voltage direct-current lamps. While with alternating current small transformers can be used to reduce the usual supply voltage, the problem involves greater difficulties in direct-current circuits. Two methods due to Neu are described. The first is as follows: If between an incandescent lamp and a direct-current network a rapid interrupter in the form of a vibrating tongue is employed, which permits the current to pass only for a fraction of the time, there will be at the lamp an apparent reduction of the voltage. This reduced voltage will equal the product of the voltage of the network by the square root of the ratio of the periods of time for which the current is closed and open respectively. If this ratio is 0.25, the voltage is reduced to one-half. It is not possible to go below 0.25 for the above ratio, and if it is desired to reduce the voltage to less than one-half it is necessary to combine the interrupter with a transformer. Special arrangements are necessary to prevent sparking of the interrupter, which would cause considerable wear and tear. At the Brussels exhibition an apparatus of this type was exhibited supplying current to a 10-cp, 10-volt metallic-filament lamp from a 220-volt direct-current circuit. The second method is based on the fact that the energy which is stored in a condenser and which, therefore, can be recovered during its discharge is proportional to its capacity and the square of the voltage of the charging current. If between the direct-current network and a low-voltage lamp a condenser and a rapid two-way interrupter are inserted in such a way that for one position of the two-way interrupter the condenser is charged from the network and it is discharged through the lamp for the other position of the interrupter it is possible to adjust the energy which will pass through the lamp in a certain time, because for a given voltage this energy will be a function of the capacity of the condenser and of the frequency of the commutator.—*L'Industrie Elec.,* Feb. 10.

Drawn Tungsten Filament.—A note on a recent British patent (2759, Feb. 23, 1911) of the British Thomson-Houston Company (General Electric Company of this country). Tungsten powder with a small percentage of carbon is made into a paste with an amalgam binder of bismuth, cadmium and mercury. This is extruded under pressure through a 40-mil die and cut into rods about 3 ft. long. After baking in a vacuum the rods are partially sintered in hydrogen. The final sintering is done at a temperature approaching the melting point of the metal in an atmosphere of hydrogen and nitrogen, and the current through the rods is reduced very gradually during several hours. It has been found that this very gradual cooling results in the tungsten rod being ductile even at ordinary room temperatures without the necessity for the prolonged mechanical working described in a previous specification.—Lond. *Elec. Eng'ing,* March 2.

Arc-Lamp Electrodes.—A note on a recent British patent (17,278, Feb. 23, 1911) of the British Thomson-Houston Com-

pany (General Electric Company of this country). Electrodes for plain arc lamps have cores containing about 35 per cent titanium carbide, 30 per cent calcium or barium fluoride, 15 per cent cryolite and 20 per cent carbon. Such compositions are particularly suitable for the positive electrodes in lamps in which the positive is situated below the negative electrode. A coreless electrode containing these chemicals can also be used.—Lond. *Elec. Eng'ing*, March 2.

Connections of Lamps.—An article giving various wiring diagrams which show how any one of a number of incandescent lamps or arc lamps can be lighted from a network while the others are out, the changing from one lamp to another lamp being done by a simple switch.—*Elek. Anz.*, Feb. 23.

Generation, Transmission and Distribution.

Steam Turbine.—E. D. DREYFUS.—The first part of a paper discussing some important improvements in construction that have developed in recent years with extended experience. High efficiencies and excellent operating performance have directly followed the introduction of the advanced designs. In the present instalment the author deals with subjects of speeds of rotation, details of design and extensions of the field of applications of the steam turbine.—*Elec. Jour.*, March.

Traction.

Weight Transfer in Electric Cars and Locomotives.—G. M. EATON.—When the axles of an electric locomotive or car are independently driven—that is, when each axle is driven by its own motor—under maximum tractive effort conditions the wheels on certain of the axles will slip on the rails in advance of the other wheels. The author discusses the fundamental principles which go to produce this result and illustrates these principles by various diagrams.—*Elec. Jour.*, March.

Installations, Systems and Appliances.

Rates for Electrical Energy.—C. KINZBRUNNER.—A paper read before the Vienna Electrical Society. The author regrets that the management of small and medium-sized central stations in Austria and Germany is still often in the hands of engineers who "lack in commercial sense." To be financially successful a central station should have a practical commercial manager and the selection of a proper and all around satisfactory rate is of importance. Ordinarily the energy is metered and paid for according to a certain rate per kw-hour in both Austria and Germany. The author thinks that this method is unjust, since every customer should pay for a certain part of the fixed cost of the station corresponding to the rating of his connections. The author has calculated for a great many typical American and English stations how much should be charged per kw-hour for consumers using electricity for greater or shorter periods per day if the total cost should be distributed justly among the different consumers. According to the figures given as average values, the cost of the kw-hour should be 2 cents for a consumption of energy during ten hours a day, 2.4 cents for eight hours, 3.2 cents for six hours, 4 cents for four hours, 7 cents for two hours and 12 cents for one hour per day. The ordinary meter rate is rendered even more unjust by allowing a discount according to the number of kw-hours used. In giving a special rate for the energy used for motor purposes it is often overlooked that many motors are also operated during hours of peak load. To overcome some of these difficulties a double tariff has been tried, but is considered to be too complicated. Another development has been a tariff based on metering energy and at the same time using a maximum-demand indicator. A flat rate has the advantages of simplicity, but the consumer may easily be led to waste energy and the determination of the proper basis of the flat rate meets with difficulties. To improve the present unsatisfactory condition in many plants the author recommends encouraging the following: Small consumers to make connections; well-to-do people should be encouraged to use electric energy for heating and cooking; for the motor load a lower rate should be allowed only when the motors will not run at times of peak load. The latter recommendation is very strongly advocated by the author. An account of the discussion which followed is also given.—*Elek. u. Masch.* (Vienna), Feb. 12.

Switchboard.—C. H. SANDERSON AND M. C. TURPIN.—An illustrated description of the switchboard of the Congressional heat, light and power plant in Washington, D. C.—*Elec. Jour.*, March.

Electrophysics and Magnetism.

Aurora.—D. OWEN.—A critical summary of recent investigations on the underlying cause of the aurora or "northern lights." In recent years two investigations have been made with the object of reproducing experimentally the phenomena actually observed on our globe. The first series of experiments was due to Professor Birkeland and was devised to support his theory that perturbations of the earth's magnetic field and polar auroras are both effects arising from the same cause, namely, the precipitation on the earth of streams of electric corpuscles shot out from the sun's surface, especially in the region of sunspots. The second series of experiments was due to P. Villard. By means of a beam of cathode rays moving in a magnetic field some of the chief auroral characteristics were strikingly reproduced. The source of the cathode beams which are thus regarded as causing the aurora is held to be terrestrial and not of solar or cosmic origin.—Lond. *Electrician*, March 3.

Dielectric Stresses.—W. S. FRANKLIN.—A paper discussing dielectric stresses from what is called the mechanical as distinguished from the atomistic or electronic point of view. The discussion is based on two ideas, namely, (a) that dielectric breakdown occurs at a definite electric field intensity, and (b) that the line of dielectric breakdown is a conducting path. The author deals with the subject under the following headings: Gauss's theorem, electric stresses in plane layers of different dielectrics, mechanical analogies, the graded cable insulation, experimental effects dependent upon inductivity, dielectric hysteresis, concentration of electrical stresses by points.—*Jour. Franklin Inst.*, March.

Resonance Curves.—J. A. FLEMING AND G. B. DYKE.—A paper illustrated by diagrams of some resonance curves taken with impact and spark-ball discharges. These curves give an insight into the operations taking place in the secondary circuit in which oscillations are created by a primary circuit used both with the impact and with the ordinary spark-ball discharger. These curves confirm the ordinary theory of the oscillation transformer and exhibit the striking difference between the action of an impact and of an ordinary spark-ball discharger. —Lond. *Electrician*, March 3.

Röntgen Rays.—W. P. DAVEY.—The modern theory of Röntgen rays states that these rays consist of rays in the ether caused by accelerations received by negatively charged corpuscles during the time in which the cathode rays penetrate the target (or anti-cathode) of the X-ray bulb. In the present paper the author gives an account of experiments made to determine the mean depth at which Röntgen rays originate within a silver target. The chief result is that this mean depth is directly proportional to the potential employed in generating the rays.—*Jour. Franklin Inst.*, March.

Bending of Electric Waves.—J. W. NICKOLSON.—A fourth paper in his serial on the bending of electric waves around a large sphere. The present instalment deals largely with the solution of some mathematical problems involved.—*Phil. Mag.*, March.

Magnetostriction.—S. R. WILLIAMS.—An account of an experimental investigation of the Joule and Wiedemann magnetostrictive effects in steel tubes.—*Phys. Review*, March.

Electrochemistry and Batteries.

Automobile Storage Battery.—D. H. FLANDERS.—A paper read before the Franklin Institute on the so-called iron-clad battery for electric vehicles. The special feature of the battery is based on the observation of a Frenchman that if the positive material could be kept in position it would remain active. He accomplished this by utilizing a pencil of lead peroxide surrounding a conducting core and inclosed in a porous tube of such elastic quality that as the active material expanded and contracted, due to changes in its molecular structure, the cir-

cular tube compensated for these variations. Thus the positive material was protected and held in position. At the same time this form, comprising, as it does, a central conducting core embedded in a cylindrical pencil of peroxide of lead, provides excellent conductivity and increased accessibility for the electrolyte, thereby rendering it possible to obtain a relatively high output from a relatively small quantity of active material.—*Jour. Franklin Inst.*, March.

Electroplating.—An article on recent improvements in electroplating appliances and chemicals based chiefly on recent German patent specifications.—*Elek. Anz.*, Feb. 16 and 19.

Units, Measurements and Instruments.

Moving-Coil Galvanometers.—A. Zeleny.—A paper giving an account of an investigation of the causes of zero displacement and deflection hysteresis in moving-coil galvanometers. The zero displacement observed after a deflection in a moving-coil galvanometer is shown, for phosphor-bronze suspensions, to be due almost entirely to the change in the intensity and direction of magnetization of the magnetic impurities within the coil. The amount due to a true set in the fiber is negligible under ordinary conditions of use, and in the cases investigated the largest true set observed was less than 6 per cent of the whole zero displacement. The hysteresis curve of the magnetic impurities within the coil shows a very large coercive force sufficient to account for the observed deflection hysteresis in moving-coil galvanometers. The upper bend of the curve is at a field intensity of about 1600, which is great compared to the corresponding intensity for iron or steel. During the progress of the experiments several other properties of moving-coil galvanometers were investigated: (1) The relation of the zero displacement to the magnitude of the reversed deflection and the change of the zero reading with time were determined. (2) The amount due to the magnetism in the galvanometer coils was found to differ considerably even in instruments of the same type and from the same manufacturer. In the similar coils tested the magnetic moment, less the diamagnetic moment, in the same field varied from 0.129 c.g.s to 0.217 c.g.s. units. (3) The values of the damping factor for the same coil in fields of different intensities were determined. More than two-thirds of the damping on open circuit was found, for ordinary galvanometers, to be due to the resistance of the air and the internal friction of the fiber and less than one-third to the induced currents. (4) The change of sensibility with the intensity of the field was determined with a coil of known magnetic properties and a suspension of approximately known torsional moment.—*Phys. Review*, March.

Measuring the Slip.—A. Brückmann.—An article on difficulties in the use of the stroboscopic method of measuring the slip of an induction motor. A black disk with a white diameter or radius is driven by the armature and is lighted by means of an arc lamp operated by the alternating current supplied to the

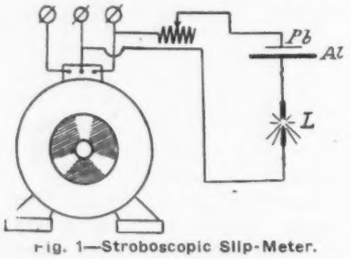


Fig. 1—Stroboscopic Slip-Meter.

stator. The disk shows as many pictures of the radius as there are alternations per revolution. For synchronism the picture is stationary and the number of radii in the form of a star equals the number of pairs of poles of the stator. When the motor is loaded and begins to slip the star begins to rotate and from the number of revolutions the slip may easily be determined. A difficulty in this method is that when the number of poles is large the star consists of a great many radii and observation is rendered difficult. This difficulty can be overcome by reducing the number of radii to one-half. This is simply done by connecting an aluminum cell in series with an arc, as shown in Fig. 1, where *L* is the arc lamp operated by the alternating current of the primary. *Al* is the aluminum plate and *Pb* is the lead plate of the aluminum cell. This arrangement permits the current to pass only in one direction, so that only one-half of the alternating current is utilized. In this way the picture of the star becomes much clearer and the observation is greatly facilitated. A nearly saturated solution of bicarbonate of soda is a suitable electrolyte and the dimensions of the electrodes should be chosen to get a current density of 0.05 amp per square centimeter (0.33 amp per square inch).—*Elek. Zeit.*, March 2.

Measuring Power in Three-Phase Systems.—A. Recke.—An article giving diagrams for the chief problems of measuring the power in three-phase systems in practice. After some brief notes on commercial wattmeters and series transformers the author discusses the connections for the following three cases: First, three-phase systems with equally loaded phases; second, three-phase systems with unequally loaded phases, and, third, three-phase systems with the neutral wire loaded.—*Elek. Anz.*, Feb. 9.

Standard Cells.—G. A. Hulett.—A paper on the construction of standard cells. The author gives detailed instructions showing how to prepare the materials needed in the Clark and in the Weston standard cells and how to put these cells together. He then emphasizes that for electrical measurements which make any pretense to accuracy an automatically controlled constant-temperature bath is indispensable for the Weston as well as for the Clark cell so that the temperature coefficient is of no consequence. He uses a thermostat which is an electrically heated and controlled kerosene bath which keeps well within 0.1 deg. for any desired length of time.—*Phys. Review*, March.

Compensation Apparatus.—K. Feussner.—The first part of a paper in which the history of the compensation apparatus as first devised by Poggendorf and as developed later by others is given with special reference to recent constructions which have been devised for use in commercial practice.—*Elek. Zeit.*, Feb. 23.

Miscellaneous.

Electric Heating.—An account of a recent electric heating and cooking demonstration at the Battersea Polytechnic Institute. There were exhibited numerous electric heating and cooking apparatus and also a portable apparatus for increasing

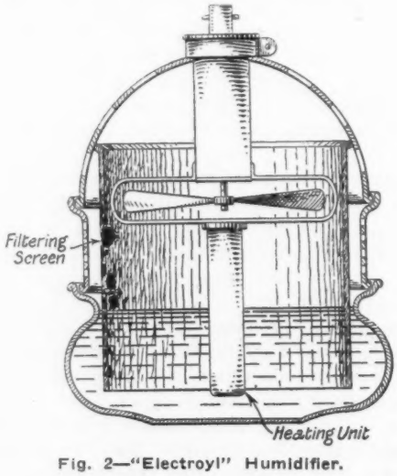


Fig. 2—"Electroyl" Humidifier.

the humidity of the air in rooms. The latter is shown in Fig. 2. The humidifier, which requires about 10 watts, comprises an evaporating basin containing a diaphragm of asbestos for increasing the surface of evaporation, while an electric fan in the upper chamber draws air through the perforated dome, seen in the illustration, and forces it out in a gentle stream through the asbestos fabric and perforated galley supporting the dome. In the lower parts of the humidifying vessel is suspended an electric heating unit for increasing the rate of production of water vapor and for controlling the temperature of the latter.—Lond. *Electrician*, March 3.

Hot Bearing.—S. LEES.—A brief illustrated note referring to a recent test in which considerable trouble was experienced with a hot bearing while it was imperative that the test run should not be interrupted. The most successful remedy was found to be in a portable air compressor which was ordinarily employed for cleaning purposes. The blower was rigged up with its discharge nozzle about 2 ft. distant from the bearing and regulated so that the current of air projected would not interfere with the proper working of the bearing oil wells.—Lond. *Elec. Rev.*, March 3.

Telegraphy, Telephony and Signals.

Telegraphy and Earth Currents.—BERGER.—An article illustrated by diagrams in which the author points out the disturbances which strong earth currents can produce in telegraph operations if a single conductor is used. The author shows how operation can be maintained even when strong earth currents occur by means of changing the single-conductor line into a loop. Not only may such loops be formed from single telegraph conductors, but also telephone conductors may be used for the purpose without causing any disturbance in telephonic transmission. Arrangements must be made so that at any time when strong earth currents may suddenly occur these changes in the connections from single-conductor to loop operation can be made at once.—*Elek. Zeit.*, March 2.

Automatic Telephone.—H. MARCHAND.—A long illustrated description of the chief features of the Strowger system of automatic telephony.—*L'Industrie Elec.*, Feb. 10.

BOOK REVIEW.

A TREATISE ON ELECTRICAL THEORY AND THE PROBLEM OF THE UNIVERSE. By G. W. de Tunzelmann, B.Sc. Philadelphia: J. B. Lippincott Company. 654 pages, illus. Price, $4.50.

This remarkable book is neither wholly a textbook on the physics of electricity nor wholly a book on the philosophy of the universe, but is a blend of the two. As a rule, the men who write on metaphysics are not physicists and the men who write on physics are not metaphysicists, so that the two subjects are kept out of bowing distance and certainly out of mutual acquaintance. In this case, however, the writer is a trained physicist, astronomer and mathematician by profession, as well as a speculative philosopher by choice.

Apart from the physics of the subject, which are very interestingly set forth by the writer, there are a number of philosophical subjects discussed; for instance, that "the external existence of an uncontrolled universe is infinitely improbable" and "the place of mind in the universe." To those who are versed both in mathematics and in speculative philosophy the book will be of great interest, but the reasoning will not be clear either to mathematicians alone or to philosophers alone. Whatever opinion may be held as to the philosophies deduced by the author, we heartily commend him for attempting to discuss these important and recondite subjects on strictly scientific lines of reasoning.

New Apparatus and Appliances

CO-OPERATIVE PUBLICITY FOR SMALL CENTRAL STATIONS.

Data recently compiled indicate that the average percentage of residences wired for electric lighting but not connected to central-station lines was about 15 per cent in the several cities investigated, while in some of these the percentage of "idle wiring" was much greater. When it is considered that in almost every community the percentage of *unwired* residences far exceeds the figures above mentioned the opportunities for the extension of residential service are at once seen to be large.

Recognizing these facts, and realizing that the lighting companies' gain necessarily involves the lamp manufacturer's gain and that their loss is his loss, the Shelby Electric Company, of Shelby, Ohio, is helping many of its central-station customers to build up their load by co-operating energetically with their new-business departments. To this end the Shelby company has prepared an extensive line of direct-by-mail advertising material which it furnishes to the lighting company at a figure considerably below cost.

The campaigns have been limited thus far to cities and towns of 15,000 inhabitants or less in the Middle Western and Southern States, but the indications are that there will be a demand for them in other states and in larger cities. The Shelby company is not attempting in any way to preëmpt the functions of the central station, but merely to place at its disposal the services and product of advertising experts, which are usually not available in the small towns except at a prohibitive cost.

Three separate lines of attack are followed in this co-operative publicity work—one being aimed at the merchants in an effort to obtain their store, window and sign lighting; another is directed at unwired residences, and the third is intended for residences wired but not using energy. Any one of these three, or any combination, may be used by the central station, according to local requirements. Furthermore, the general outline of each campaign is modified to meet special conditions, and is always made to include any new-business proposition which the central station may care to offer, such, for example, as a deferred-payment plan for residence wiring.

The mailings consist of a series of carefully prepared letters and attractive advertising inclosures. The low cost of electric lighting made possible by modern high-efficiency incandescent lamps is used as a strong argument to convince the prospective customer of his need of central-station service.

BURKE SHORT-CIRCUITED TYPE INDUCTION MOTOR.

The induction motor developed and built by the Burke Electric Company, of Erie, Pa., although of the short-circuited type, makes use of no conductor bars jointed to end rings as in the ordinary forms of these machines. Each rotor circuit, as shown in Fig. 3, is made from a single solid piece of copper, first cut as in Fig. 2 and then bent into the formed shape of Fig. 3. The heavy secondary currents induced in the rotor thus have a continuous solid metal path over which to flow and all possibility of joints to end rings heating and loosening, as in bolted or soldered rotors, is avoided. The absence of end rings in the Burke motor is also said to produce less leakage, giving higher starting torque.

The end brackets of the motor are fitted into the stator housing, insuring accurate centering in any position of the motor. Bolts enable the brackets to be withdrawn easily, without hammering or filing. The oil rings used in the bearings of these machines are made up of a number of thin flat rings, loosely hung in the shaft channel. Capillary attraction in the spaces between these flat rings causes a much greater quantity of oil to be brought up than with single-ring oiling bearings, insuring that the shaft shall be at all times supplied with ample lubrication. Accurate workmanship is a special feature of the Burke motors throughout, all parts being carefully built to standards so that they become interchangeable, resulting in convenience and economy. In general, the over-all dimensions

are also the same as those for the direct-current machines of the same manufacture. These alternating-current induction motors are built in sizes up to 250 hp. For motors of over 7.5 hp resistance or auto-transformer type starters are furnished as standard equipment. The oil switch for the auto-transformer type is built separate from the auto-transformer itself, and can be mounted near the operator's hand, if desired, so that the machine can be started without the operator leaving his work. The oil-immersed switch contacts are of the knife-blade type, insuring solid contact when closed. The Burke Electric Company also manufactures slip-ring motors for adjustable-speed duty, and for use where high starting torque with small starting current is desired.

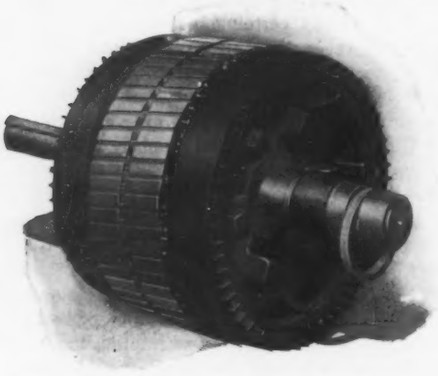
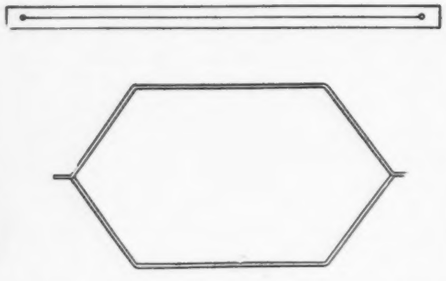


Fig. 1—Rotor of Induction Motor Complete, Showing Multiple Oil Rings.



Figs. 2 and 3—Rotor Bar Before and After Forming.

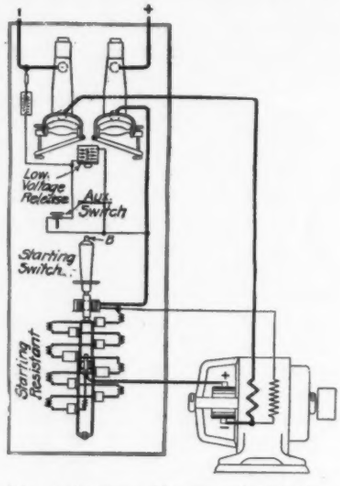


Fig. 2—Wiring Diagram of Direct-Current Motor-Starting Panel.

MOTOR-STARTING PANELS FOR HEAVY DIRECT-CURRENT SERVICE.

The General Electric Company has recently designed and built a number of direct-current motor-control panels to meet the requirements of heavy service and safety. The accompanying illustrations show the rugged character of these panels.

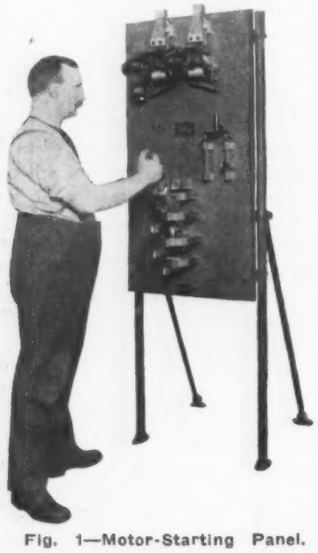


Fig. 1—Motor-Starting Panel.

The equipment consists of a slate panel mounted on 1¼-in. pipe supports and braced to the floor or wall by means of pipe braces. The panel carries a double-pole carbon-break circuit-breaker, a single-pole four-throw or nine-throw starting switch and an optional double-pole field switch, with necesary interlocks, connections and small resistors. The starting resistors are usually set on the floor and connected to the switch by means of leads. When the equipment is for a small motor suitable arrangements can be made for mounting the starting resistor on the panel pipe suports. It is impossible with this switch to operate otherwise than step by step. A pawl on the handle lever engages in teeth on a ratchet wheel rigidly attached to the contact blade. As the handle is operated back and forth with a sort of pump-handle motion the ratchet wheel is turned and thus the blade is moved from one contact to another. The circuit-breaker and starting switch are interlocked in such a manner that the circuit-breaker cannot be closed until the starting switch is in the "off" position. Also, if after the circuit-breaker is closed and the starting switch is in an intermediate position the operator removes his hand from the starting switch handle the circuit-breaker will immediately open. Where a field switch is supplied it is also interlocked with the circuit-breaker so that the latter cannot be closed unless the field switch is closed. The opening of the field switch causes the circuit-breaker to trip.

CONTINUOUS LUBRICATION OF SMALL ENGINES.

It was not thought necessary until recently to equip small engines with continuous oiling systems. The engineer or owner of a small power plant was content to lubricate his engine by the old hand method of oiling, and a continuous system was looked upon as a necessity in very large plants only. The economies effected by the use of continuous oiling systems in large plants have been so great, however, that no plant, large or small, is now considered complete unless proper provision is made for continuous lubrication of all bearings. The Pittsburgh Gage & Supply Company, Pittsburgh, Pa., has for many years made a specialty of lubrication, and in addition to manufacturing and installing oiling systems for the largest engines has designed a system for the continuous lubrication of the smallest plants. It is known as the "White Star" individual continuous oiling system, and is particularly well adapted for the continuous lubrication of steam and gas engines, ice machines, turbines, pumps, compressors and machinery of 500-hp capacity or smaller. The system consists of a "White Star" (engine-type) filter with pedestal for attachment to engine frame, automatic drain tank, pump, necessary sight feeds, compression fittings and steel tubing.

The system has the advantage of simplicity, and a copious supply of oil is furnished to the bearings. The manufacturer points out that the same oil may be used over and over without rehandling and the constant circulation prevents friction and wear.

AN IMPROVED "FLOODED" SYSTEM FOR FREEZING TANKS.

In the ordinary or so-called "dry" expansion system of ammonia refrigeration, in which the ammonia liquor is allowed to expand in expansion coils in contact with the brine to be chilled, the compressed liquid hardly passes the admission valve before its release in pressure allows it to convert itself into gas, continuing as such in its passage through the rest of the freezing pipes. This rapid conversion into gas near the beginning of its path through the expansion coils has several disadvantages. In passing from liquid to gaseous form the ammonia, of course, absorbs a quantity of heat of vaporization. Where the change is allowed to take place rapidly near one end of the expansion system most of the heat is abstracted at this point and a low temperature is there reached, while other parts of the freezing pipes are not worked to their full capacity. A second and most serious disadvantage of the dry system is due to the poor thermal conductivity of the expanded ammonia gas. Like air or any other gas it conducts heat slowly; consequently the pipes in the latter part of the expansion system are prevented from getting the full chilling effect of the gas passing through them, due to the insulating qualities of the gas itself.

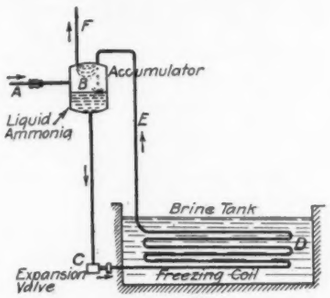


Fig. 1—Elementary "Flooded" Ammonia Freezing System.

To correct these drawbacks and improve the efficiency of the chilling apparatus the "flooded" system of operation was developed. In this scheme more liquid ammonia than can actually expand in its passage through the chilling coils is introduced into the system. As the liquor enters the expansion coils part of the ammonia vaporizes, but the rest of it remains liquid, the gas and liquid following each other through the pipes in the form of alternate slugs. During the passage through the coils more and more of the liquid is gasified, the liquid slugs becoming smaller. The quantity of ammonia is so adjusted, however, that a small amount of liquid will be carried unevaporated though to the end of the expansion coils. This surplus liquid is then allowed to drop back into the accumulator containing the liquid ammonia from which the coils are supplied, and undergoes another passage of the expansion coils, so that no compression work is lost. The expanded gas is meanwhile drawn off to the compressor and reliquefied.

Since alternate slugs of liquid and gaseous ammonia follow each other through the expansion coils, the liquid slugs evaporating during the passage, it is evident that expansion occurs more uniformly throughout the coils and the refrigerating action more nearly works all parts of the system at its rated capacity. Again, the liquid inside the coils produces wetted surfaces, which by the expansion taking place cool rapidly in intimate contact with the pipe material. The expansion of the liquid in other parts of the pipes is also able to extract heat more rapidly through the liquid slugs in contact with the pipe than were only the thermally insulating gas present.

The flooded system of operation thus enables the expansion coils to be worked at nearly 75 per cent higher thermal density and efficiency. About 60 per cent more ammonia is required to charge the flooded system, but as this material always remains in the pipes and the work required to compress the part expanding is the same as before, the flooded system of operation costs little more than the older dry-expansion system, while it secures many advantages.

In the usual forms of the flooded apparatus the ammonia accumulator which supplies the hydrostatic head for forcing the ammonia through the pipes is installed outside of the brine tank, as in Fig. 1, which shows the operating parts of an elementary flooded system. In the diagram the liquid ammonia comes from the compressor through pipe *A*, drops into the receiver *B*, where a liquid level is maintained sufficient to force it through the expansion valve *C* and into the expansion coils *D*. Here it expands, the gas and liquid slugs rising in the coils, which they leave at *E*. On their way back to the compressor they again pass through the accumulator *E*, the liquid part dropping into the liquid contents of the accumulator and the gas being drawn to the pump through *F*.

In a new and improved form of the flooded system recently developed by the York Manufacturing Company, York, Pa., makers of compression and absorption-type refrigerating apparatus, the liquid ammonia accumulator is partially immersed in the brine tank, thus conserving the expansion, which, as later explained, goes on here, applying it usefully to the brine to be cooled. The improved arrangement is shown in elevation in Fig. 2, the ends of the freezing coils being seen behind the upright accumulator. As shown in dotted lines, the incoming ammonia-liquor pipe from the compressor is brought through spiral coils in the accumulator, further serving to hold at a low temperature the liquid contents of this tank. But from the outlet end of the spiral the liquid ammonia passes directly to the expansion coil. The exit end of this coil opens into the accumulator tank, whatever slugs of liquid ammonia may come over being thus dropped to the bottom of the tank, while the gas is withdrawn from the top by the pump. The liquid ammonia which drops into the accumulator, however, is, of course, in the brine tank like any part of the expansion system and consequently soon evaporates, doing its part toward cooling the brine. In the gaseous form which it now assumes it, too, rises and is pumped back to the compressor, leaving any residuum of impurities in the bottom of the accumulator. From this they can be withdrawn through a special tap pipe provided for the purpose. The improved system is thus seen to effect a continuous purification of the ammonia, while the circulation of the liquid and gas slugs is not dependent upon gravity feed as in other systems, being propelled by positive pumping action from the compressor.

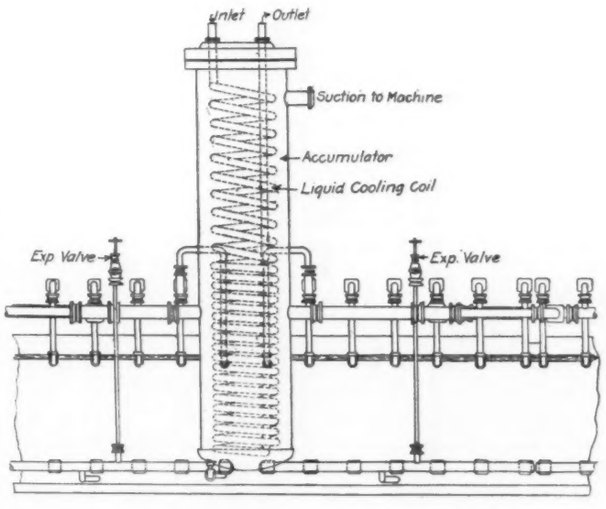


Fig. 2—Improved Accumulator Arrangement for Flooded System.

IMPROVEMENTS IN FREEZING-TANK EQUIPMENT FOR ICE PLANTS.

As has already been pointed out in these columns, the "flooded" system of ice-making, in which part of the ammonia traversing the expansion coils passes clear through the system without being expanded into gas, effects an increase in refrigerating efficiency of about 75 per cent. This is due to

Freezing Tank, Showing Circulation of Brine.

the superior thermal conductivity of the liquid ammonia, compared with the gaseous form, in extracting the heat from the brine, as well as to the intimate contact of the freezing pipes with the evaporating wetted surfaces of their interiors. The cooling is also more uniform, since evaporization of the ammonia liquor takes place all along the expansion pipes, instead of directly at the expansion valve, as in the ordinary dry system. This gain of 75 per cent in refrigerating efficiency is made with no other outlay than the addition of about 50 per cent to the ammonia charge put into the system. As the liquid ammonia which traverses the freezing pipes unevaporated is dropped back into an accumulator and returned through the coils again, no additional work of compression is imposed upon the compressor pump by flooded operation.

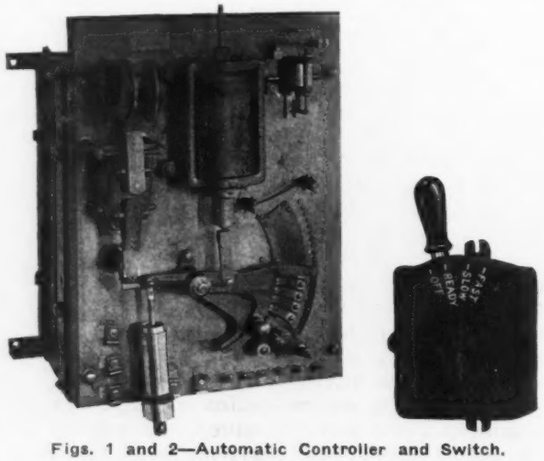
The Frick Company, of Waynesboro, Pa., makes use of several improvements in its flooded type of ice-making equipment, among which is a balanced check valve in the liquid return line from the accumulator to the discharge from the coils. Both ammonia gas and ammonia liquid come over to the compressor pump in more or less intimate quantities in a flooded system and means are required for separating these materials. The tank or trap provided for this purpose is technically known as an "accumulator," and through it there rises the suction line from the tank coils. This trap, or accumulator, should be of sufficient depth to permit the liquid to drop to the bottom while the gas is conveyed off at the top and thence travels to the machine. The liquid which finds its way to the bottom of the accumulator is carried back to the freezing coils in the tank by gravity by a connection between the bottom of the accumulator and the liquid feed header in the bottom of the tank. Here, again, however, the discharge from the tank coils tends to follow the line of least resistance, and the direction of the flow must be determined by some device at once automatic and positive. Without this there would exist the impossible condition of having gas and liquid connections at both ends of the accumulator and only one direction for both —toward the machine.

A balanced check valve was accordingly devised and placed in the liquid return line from the bottom of the accumulator to the liquid header in tank, thus obliging the discharge from the coils to flow in but one and the desired direction. The application of the balanced check valve to this use is being patented by the Frick Company.

A second important refinement of the Frick freezing-tank apparatus is the improved brine circulation obtained by the arrangement of bulkheads in the tank so as to secure the best circulation of the fluid. As shown in the illustration, the middle bulkhead is shortened at the far end of the tank, leaving a passage having a cross-section equivalent to that between the rows of cans themselves. Obviously, this free passage across the ends of the tank is imperative if satisfactory circulation of brine is to be secured. The propeller furnished for agitating the liquid is also of ample size, as experience has shown that a small propeller running at high speed tends simply to churn the water uselessly, giving low efficiencies of brine movement. With good circulation of the brine the blocks of ice freeze evenly throughout the cans, and all parts of the liquid are kept at more nearly even low temperature, the warmer brine being removed from the top and the colder liquid near the bottom being disseminated throughout the tank.

PRINTING-PRESS CONTROLLERS.

Recent developments in the control of printing-press machinery have been in the direction of automatic or magnetically operated devices. For some classes of work much better results can be obtained by magnetically operated devices, which permit of adjustments from several locations and insure safety to pressmen. One of the types recently standardized in sizes from 1 hp to 7½ hp by the Cutler-Hammer Manufacturing Company, Milwaukee, Wis., is shown in Fig. 1. This controller, particularly adapted for flat-bed presses, gives a speed reduction of 50 per cent below normal by armature resistance and an increase up to 2 to 1 by shunt-field resistance. A solenoid switch is used to break the motor circuit. The controller lever is divided into two parts, the rheostat arm and the operating arm, which latter is connected to the oil dash-pot and the solenoid plunger. The operating arm moves the rheostat arm by means of a spring-pressed pin which may be set in any one of a series of holes in the rheostat arm. In this way it is possible to adjust the travel of the rheostat arm and, therefore, the speed to which the motor will be brought by the self-starter. Adjustments are provided so that the rheostat arm may be left continuously on any of the armature or field contacts. When adjusted to any printing speed the press will always be brought to this speed. A lock may be added to the operating arm, locking the pin in place so that the press must then be operated at the speed determined by the foreman. The control switch, Fig. 2, is of the lever type inclosed in a substantial metal case. A centering spring holds the lever in the "ready" position. Moving the lever to the left stops the motor, and if the lever



Figs. 1 and 2—Automatic Controller and Switch.

is locked in this position by a latch provided for that purpose it is not possible to start the press from any point. This is the "safe" position. Moving the lever from the "ready" position one step to the right closes the main-line solenoid switch and starts the motor. If the lever is then returned to the "ready" position the motor will continue to run slow. Moving the lever to the extreme right energizes the self-starter magnet and the motor is automatically accelerated to the printing speed.

ELECTRIC HEATING PAD.

The heating pad made by the Phelps Manufacturing Company, Detroit, Mich., is 8 in. long by 5.5 in. wide and is covered with high-grade red felt and connected by 10 ft. of approved silk-covered conducting cord. When connected to a lamp socket the manufacturer claims it will heat up in from two

Electric Heating Pad.

to three minutes. An automatic regulator is provided to maintain an even temperature indefinitely and to render it impossible for the pad to become too warm. The pad is somewhat smaller than the usual pad, being more nearly comparable to the familiar hot-water bottle in size, but the latter is absolutely incomparable to the electric pad in service.

INDUCTION WATT-HOUR METER.

The induction watt-hour meter brought out by the Sangamo Electric Company, Springfield, Ill., employs the well-known rotating-field principle. The simple field arrangements characteristic of the well-known Gutmann meters, with the additional improvements suggested by broad experience in the meter art, have been incorporated, thus securing a construction insuring high initial and permanent accuracy.

The complete meter is shown in Fig. 1 with cover removed and the principal elements indicated. Figs. 2 and 3 show the main grid removed from the base, giving a clear idea of the structural features.

The main grid is made of vanadium-aluminum alloy, having absolute freedom from tendency to crystallization and warping. The weight of the permanent magnets, series measuring element and return plate is carried on the main portion, the smaller projecting brackets of the grid carrying no weight except that of the moving system, adjustments and recording train. The moving element consists of a light aluminum disk mounted on a short shaft, the entire system weighing 18 grams. The disk is swaged under heavy pressure. The upper pivot is made of highly tempered steel wire and of such a diameter as to be quite flexible in the length between the top of the shaft and the guide ring in which it rotates. This guide ring, which has its bearing hole "olived" and burnished, has a long brass sleeve closely surrounding the upper pivot of the spindle, so that any blow against the moving system caused by accident or short-circuit will slightly deflect the shaft until the steel pivot touches against the side of the shell. This prevents danger of breaking off or bending the upper pivot, and offers a cushioning or flexible action between the shaft and the bearing shell, eliminating vibration, rattling or humming. The lower pivot arrangement consists of a hardened polished steel wire tip having both ends rounded and polished. This tip slips friction-tight into a hole drilled in the lower end of the brass shaft

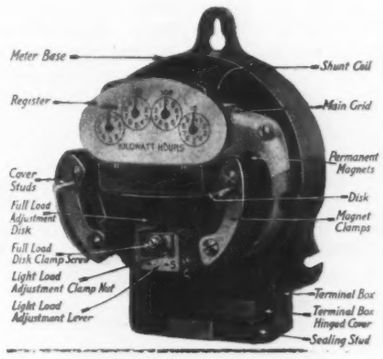


Fig. 1—Induction Watt-Hour Meter.

split so as to compress on and firmly hold the pivot. The lower bearing consists of a ring stone and end stone of sapphire and offers several advantages over the cup jewel.

As is generally known, the shunt or potential coil of an induction meter occasionally breaks down or burns out, due to abnormal line conditions or accident. In such cases the replacement of a coil is usually a difficult matter. With the new design the entire shunt magnet with its coil is held to the base by two dowel pins and four screws, enabling removal as a unit. A new core and coil may thus be substituted without removing and replacing laminations. The laminated core has but a single air-gap, in which the disk rotates. The laminations forming the core are laced into the shunt coil and then subjected to hydraulic pressure, the rivets being set at the same time, so that the whole forms a compact non-vibrating unit, eliminating humming. The series coils are mounted on a laminated iron structure having a laminated return plate forming an air-gap in which the disk rotates. The design of the curved magnetic return plate, with laminations placed edgewise to the field below, gives a maximum radius of action for

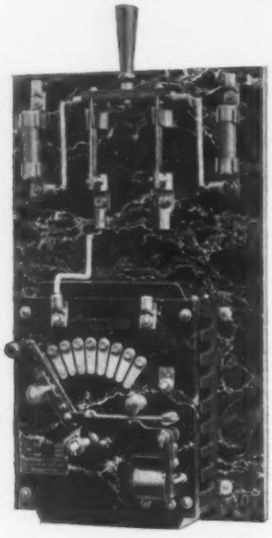
Fig. 2—Shunt Coil.

Fig. 3—Series Coils and Grid.

both the series and shunt fields. The gap of the shunt field in which the disk rotates projects in between series magnet poles, the return plate curving so as to clear the shunt magnet. This gives the desired proximity of shunt and series fields, with a maximum radius of action for both sets of fields. Full load adjustment is effected by simply raising or lowering a micrometer-supported magnetic disk shunt in proximity to the permanent magnets.

UNIVERSAL SPEED REGULATOR.

The motor speed regulator shown in the illustration is made by the Independent Electric Manufacturing Company, of Milwaukee. The regulator and its resistor are mounted as a unit on a marbleized slate panel. The resistor is contained in a substantial box, on the face of which the regulating device proper is mounted. This consists of a wrought-iron lever provided with a handle and having a contact shoe and a link to which a rack is attached. As the lever is moved over the contact segments the no-voltage release magnet, by attracting



Universal Speed Controller.

its armature (which carries a spring at right angles to it), forces the rack to engage a V-shaped pin. The notches on the rack are so spaced that the lever can remain in position only when the contact shoe rests squarely upon a segment. This pin-and-rack arrangement is believed to add materially to the efficiency of the controller. If the rack should become worn after a considerable period of service it can be removed easily and a new rack attached to the link without discarding the entire lever. The back panel contains the usual knife switch and fuses. It is pointed out that this type of motor speed regulator is entirely self-contained.

ALTERNATOR FOR HIGH-SPEED TURBINE DRIVE.

The three-phase turbo-alternator illustrated herewith has recently been constructed by the Electric Construction Company, Ltd., London, to the order of the Wolverhampton Corporation. It presents several interesting features of design, particularly in the construction of the rotor center and in the scheme of ventilation. The machine is designed to give 2000 kva at 85 per cent power factor, 6600 volts, 50 cycles, 1500 r.p.m., but it must also give 3000 kva continuously without excessive heating.

The most important feature of the machine is its rotor construction, the center being made from a solid block of steel. As will be seen from Figs. 2 and 3, the rotor winding consists of four coils per pole distributed in slots parallel to the pole axis. This arrangement obviates the necessity for deforming the coils, as is usually the case with former-wound coils when placed in radial slots. The end connections of the coils are also embedded in slots which lie in planes parallel to the shaft. The end connections of the outside coil of each pole are held in position by gun-metal brackets.

The stator winding is of the "bow" type, with coils lying in two different planes. This type of winding lends itself to a very rigid method of clamping. The machine is arranged for forced ventilation. Each of the inlet pipes which are placed at each end of the machine is subdivided into two different channels; one takes the air into an annular chamber, which delivers

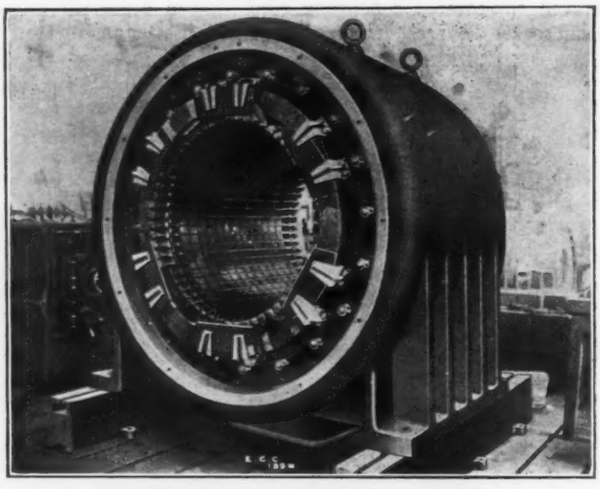


Fig. 1—Stationary Armature of Turbo-Alternator.

it through round longitudinal holes in the rotor and thence to the stator by means of suitable radial air ducts, while the other channel is mainly intended to convey the air for cooling the stator windings. The air passing through these two channels

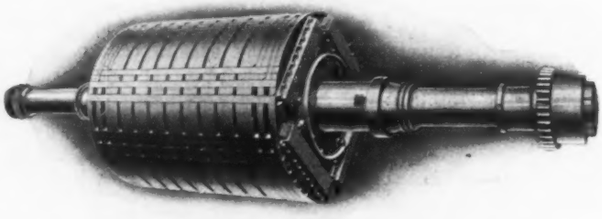


Fig. 2—Revolving Field Structure of Turbo-Alternator.

meets at the back of the machine, thereby cooling the iron and leaving by way of the outlet pipe below the stator. Each of the channels contains an air valve, which allows of proper regu-

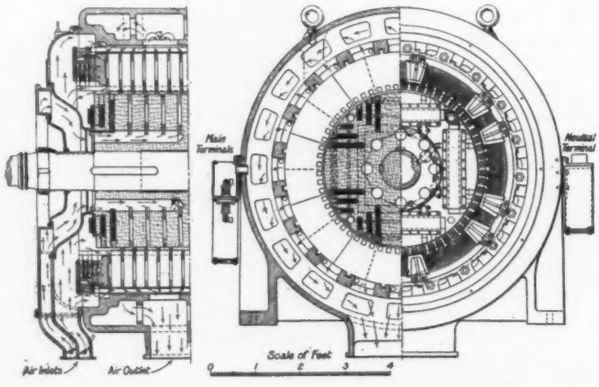


Fig. 3—Sectional Views of Turbo-Alternator.

lation so that extravagant expenditure of power for ventilation purposes may be avoided. The quantity of air passing through the machine under the heaviest condition of load is estimated to be 10,000 cu. ft. per minute.

Industrial and Commercial News

THE WEEK IN TRADE.

BUYING in the wholesale market was quieter last week and less encouraging than in any of the several weeks immediately preceding. Quite a number of the buyers who have been visiting the central markets returned home without placing orders to await more definite information as to the trend of spring retail trade. The latter was not such last week as to offer much promise, having been sharply checked by the cold snap which spread over the greater part of the country. All branches of the textile industry continue to be dull. From manufacturer to retailer reports are unsatisfactory. Crop conditions show no discouraging feature. The reports from the winter wheat area are optimistic, and it is the general opinion that the South will plant a largely increased acreage in cotton. All over the country there have been heavy purchases of fertilizers and implements, and these, it is believed, have done much to restrict rural buyers in general lines. In the iron and steel industry there has been some recession from the relatively active bookings of February, but still orders are being received at a much better rate than they were in the latter quarter of 1910. Rail orders for domestic account are small, but the promise of the export trade was never brighter. Railroads generally have not expressed a determination to curtail equipment purchases but are buying under an extremely conservative policy. Building materials and structural iron are not particularly active, especial dullness being exhibited in metropolitan districts. Many branches of industry are again disturbed by the prospective rearrangement of tariff schedules, which is adding greatly to the disposition to postpone making important commitments. Collections are irregular and can hardly be classed as fair. Business failures for the week which ended March 16, as reported by *Bradstreet's*, were 251, as compared with 230 the previous week, 208 the same week in 1910, 224 in 1909, 303 in 1908 and 157 in 1907.

THE COPPER MARKET.

IRREGULARITY and unsettled conditions again marked the copper market last week. There were almost daily price fluctuations of from 5 points to 10 points in electrolytic and at the low points there was a fair amount of buying for April, May and June deliveries. The majority of these orders came from wire-drawers and manufacturers of electrical equipment, who were buying to cover orders for the manufactured product. Prices for lake copper were materially reduced during the week by outside producers and the Amalgamated interests were forced to meet the concessions in order to make sales. The big company, however, refused to meet the lower levels of prices on electrolytic and in consequence the majority of the sales were made by independents. It is reported that the price in the sales to the wire-drawers was between 12.20 cents and 12.25 cents per pound. Bare wire was reported to have been sold as low as 12½ cents, but the lowest price announced was 12¾ cents. In spite of this small flurry of activity in electrolytic and in wire, the market for casting copper has been extremely dull. The mills report a decrease in business of from 30 per cent to 50 per cent within the last few weeks and the brass founders have experienced a decrease of at least 25 per cent. The most important trade feature of the week was, of course, the absorption of the United Metals Company by the Amalgamated company. The United company has for years been the dominant selling feature of the market. It was the habit of this company to fix a minimum price and to hold to it tenaciously even when the independents were selling lower. This refusal to meet competition often meant that the big company did not get its full share of the sales. The Amalgamated copper interests have always been in favor of a free market and it is believed that the old policy of the United Metals Company will be abandoned and that the Amalgamated will sell copper according to condition of the market and meet competition without hesitation. Exports of copper are not heavy so far in March. Thus far, including March 20, they have amounted to 13,401 tons. The daily call on the Metal Exchange March 20 quoted standard copper as per the accompanying table.

Standard Copper.	Bid.	Asked.	Settling Price.
Spot	11.80	11.90	.....
March	11.80	11.90	11.85
April	11.80	11.90	11.85
May	11.80	11.90	11.85
June	11.80	11.90	11.85

The London market, March 20, was as follows:

	Noon. £ s d	Closing. £ s d
Standard copper, spot	54 17 6	54 18 9
Standard copper, futures	55 10 0	55 11 3

Extreme fluctuations for this year:

	Highest.	Lowest.
Standard	12.30c	11.85c
London, spot	£56 15 0	£53 15 0
London, futures	57 12 6	54 10 0
Best selected	60 5 0	58 0 0

INDUSTRIAL AND COMMERCIAL NOTES.

Insulated Wire and the New Specifications.—Manufacturers of high grades of insulated wire are very much encouraged in a business way over the adoption of new specifications for rubber-covered wire by the New York City Building Department. These specifications were published in the *Electrical World* Feb. 2, and will take effect April 1. These specifications call for drastic tests of insulated wire which are far more thorough than any as yet provided. It is believed by the insulated-wire manufacturers that these tests are such that only the best of genuine Para rubber insulation will be able to pass them and that therefore the cheaper products which have been disturbing insulated wire prices for several years past will be driven from the market. It is charged that the insulation of these cheaper materials contains little real rubber and that the substitutes which are used will be unable to pass muster. The bi-annual rules of the National Fire Underwriters are also being prepared at this time and will be promulgated in April, although they will probably not become effective until August or September. These rules are expected to be fully as drastic as those adopted by New York City and to require practically the same tests. Speaking of the benefit to the insulated-wire trade in general, J. B. Olsen, of the Habirshaw Wire Company, said: "Wire trade is fair at the present time, and there are a great many inquiries looking toward future business. I believe that the adoption of the new rules by the New York department and the certainty that the National Board of Underwriters will follow the same general lines of rigid tests will do much to settle the present disturbed condition of the trade. It will certainly establish a standard of merit under which the makers of inferior material cannot compete. The established makers of insulated wire with high reputations have never been willing to cheapen their product and in consequence have been compelled to sell on a ruinously small margin to meet the prices of inferior materials which were able to pass the old rules. This will no longer be the case. I think also that the scale of prices for insulated wire will probably be advanced. Standard rubber-covered wire, No. 14, is now selling at about $6.80 per 1000 ft. The cheap and inferior product has been put upon the market at something like $5.45 and this made competition severe. Under the new rules I expect to see the price of standard No. 14 vary from $8 to $9, according to the price of crude rubber, and, as I said before, the inferior material will be shut out. Altogether, the prospect for the insulated-wire men is brighter at present than it has been for many months."

Tariff on Carbons.—It is the general impression among the carbon importers that the extra session of Congress which will convene next month will not go into the question of the tariff on lighting carbons. It is believed that if the tariff is taken up at all it will only be for the consideration of a few of the very important schedules. Carbons are comparatively a very small matter and there will be no organized effort among the importers to call this subject to the attention of Congress until after the regular term convenes next December.

Dissolution of Trade Associations.—The recent dissolution of the American Association of Electric Motor Manufacturers has been followed, according to rumor, by similar action on the part of associations representing, respectively, manufacturers of lamp sockets, safety fuses and flush and snap switches.

Electrical Water-Works Pumping in Chicago.—A contract for supplying and erecting the two electrically driven centrifugal pumps to be installed in the West Side pumping station of the Chicago water-works system has been awarded to the Platt Iron Works Company, of Dayton, Ohio, for $53,949. The plan of using electrical energy supplied from the hydroelectric plant of the Chicago Drainage Canal to operate pumping stations in Chicago has been alluded to previously in these columns. Each unit is a horizontal-shaft single-stage pump direct-connected to an alternating motor and capable of delivering 25,000,000 gal. daily under a total head of 115 ft. The contract includes starting apparatus, switchboard, instruments, oil switches, exciters and transformers to reduce the line voltage of 12,000 volts to 440 volts, which is the working potential. Synchronous three-phase, 60-cycle motors of 1000 hp or 8000 kva rating are specified. There will be seven 275-kva water-cooled, oil-insulated transformers, including two banks of three each and one spare transformer not connected. Each motor is provided with an exciter. It is expected that the installation will be ready for service about Sept. 1 of this year.

Electrical Construction.—Among the items printed under Construction News in our present issue are announcements of proposed new plants or considerable extensions to present plants at Sunbury, Pa.; The Dalles, Ore.; Salt Lake City, Utah; Cheyenne, Wyo.; Wausau, Wis.; Lethbridge, Alta., Can.; Springfield, Mass.; Elko, Nev.; Spokane, Wash.; West Sand Lake, N. Y.; Denver, Col.; Jacksonville, Fla.; Waukegan, Ill.; Kenton, Ohio; McDonough, Ga.; Bowling Green, Ky.; Ashtabula, Ohio; Kansas City, Mo.; Cincinnati, Ohio; Roland, Ia.; Southington, Conn.; St. Louis, Mo.; Kennett, Cal.; Fort Omaha, Neb.; Coldwater, Kan.; Hamilton, Ohio; Lethbridge, Alta., Can.; Ogden, Utah; Pulaski, Va.; San Francisco, Cal.; Evansville, Ind.; Columbia, Mo.; Cedar Rapids, Ia.; Kalamazoo, Mich., and Albany, N. Y.

Georgia Power Company.—Charles O. Lenz, chief engineer of the Georgia Power Company, says that construction machinery is now being installed and that work upon the plant at Tallulah Falls will be begun within a few weeks. A temporary water-power development has been arranged and an 1100-hp air compressor is being installed. It is necessary to drive a tunnel 6500 ft. through solid rock, and this will be done before work on the dam is pushed. The dam will not be an extensive affair, and will contain only about 30,000 yd. of masonry. From the mouth of the tunnel to the power house the water will be carried in a steel pipe, and the operating head will be 600 ft. It is not expected that the development can be completed in less time than two years.

Union Switch & Signal Company.—At the annual meeting of the stockholders of the Union Switch & Signal Company last week the profit-sharing plan proposed by the board of directors was unanimously indorsed. The directors are authorized to set aside or to sell 2000 shares, or any less amount, of the authorized and unissued common stock to or for the benefit of such employees as the board shall consider proper. The stock is to be sold to employees at a price fixed by the directors, not less than par, and upon terms of easy payment. The following were elected to the board of directors: John F. Miller, George Westinghouse, William McConway, George C. Smith, Thomas Rodd, H. G. Prout and James P. Donnell. The old officers were re-elected.

Yadkin River Power Company.—A charter has been granted at Raleigh, N. C., for the Yadkin River Power Company which will take over the unfinished development of the former Rockingham Power Company at Blewitts Falls on the Yadkin River. The new company has been formed by the reorganization committee of bondholders, represented by the Colonial Securities Company, of Boston, which took over the property under foreclosure last December. The capital stock of the new company is $4,000,000 and it is proposed to begin construction work immediately. Under the original plans of the Rockingham Power Company it was expected to develop 30,000 hp.

Manitou-Cripple Creek Electric Railway.—It is given out in Colorado that a group of Colorado Springs capitalists in conjunction with Eastern financiers have prepared plans for the construction of an electric railway from Manitou to Cripple Creek. The route was surveyed last summer, and it is claimed the average grade is not over 3 per cent, while the line will be several miles shorter than the present roads. The proposed road starts from Manitou and winds about the north side of Pike's Peak until it reaches a point about half way to the summit, where it will strike into the hills between Pike's Peak and the gold camp. When the route was surveyed a branch was located to run to the top of Pike's Peak, which will be operated for the benefit of tourists in the summer.

New Traction in Pittsburgh District.—Construction work will begin June 1 upon the line of the Pittsburgh, Butler, Slippery Rock, Grove City & Northern Street Railway Company, which was last week granted a charter in Pennsylvania. The construction of this road, which will be sixty miles long, will cost more than $3,500,000 and will make possible the linking of Pittsburgh with Buffalo and Cleveland by trolley. From Grove City a spur will be constructed to Meadville, Pa., where it will join lines connecting with Erie, Pa. Charles Gibson, Jr., who promoted the Pittsburgh & Butler Electric Railway, is president of the new company and J. H. Barrett will be the engineer in charge.

American Telephone & Telegraph Company.—It is given out by the American Telephone & Telegraph Company that its engineers have, within the past few weeks, perfected an improvement on the Pupin patent which adds to the carrying capacity of long-distance lines 40 or 50 per cent. It is also announced that a long-distance line is now perfected between New York and Denver, a distance of almost 2000 miles. Estimates of the construction requirements of the Bell companies for 1911 place the total outlay at about $60,000,000.

Electric Trucks for Brewers.—According to information given out by the General Vehicle Company, the big breweries of the city are just beginning to realize the economies and advantages to be derived from the use of electric power trucks. Since Jan. 1 the General Vehicle Company has sold fifty-five five-ton trucks to the city breweries, one customer alone having ordered twenty-two. Practically all of the big beer makers of the city are now using five-ton trucks for keg delivery and three and one-half-ton trucks for bottle delivery.

California Hydroelectric Development.—A project has recently been started in California to build a dam at the junction of the Middle Fork and North Fork of the American River about two miles east of Auburn. H. C. Whitman, of Stockton, has filed an appropriation for 100,000 in. of water, 4 in. pressure, flowing in the American River in El Dorado and Placer counties. From the dam, which will be 200 ft. high, he proposes to conduct the water about four miles down the stream to the power plant.

Bush Terminal Locomotive.—The General Electric Company has sold to the Bush Terminal Railroad Company a forty-ton electric locomotive for use at its yards and docks in South Brooklyn. This locomotive is a duplicate of one purchased last year by the same company. The Bush Terminal Railroad now employs four electric locomotives in its switching service. The recent sale is type "M" control with four General Electric 55-hp motors. It is operated by overhead trolley.

Power Project in Cobalt District.—A new power company for the Cobalt district of Canada has been chartered by the Provincial Secretary. The capital stock will be $7,500,000. It is to be known as the Northern Ontario Light & Power Company, and it is understood that it will take over the present light and power systems of Cobalt and Haileybury. It may also absorb the hydroelectric system now supplying power to the Cobalt mines.

J. G. White & Company.—J. G. White & Company, construction engineers, have undertaken to build an interurban line from Davenport to Muscatine, Ia. The line also will pass through the towns of Blue Grass, Pleasant Prairie and Sweetland. It will be 28 miles in length, and will operate in conjunction with the Tri City Railway & Light Company of Davenport.

Electric Pump Specified.—The City of Prescott, Wis., will receive bids up to March 30 on a 20-hp motor and duplex or triplex pump. Plans and specifications are on file in the office of the city clerk and with the Oscar Claussen Engineering Company, St. Paul, Minn.

Kiewert Lamps in San Francisco.—The Merchants' Association of San Francisco has purchased fifty Kiewert flaming-arc lamps for use in the business center. The cost of maintaining these lamps will be paid by the Merchants' Association and not by the city.

Financial.

THE WEEK IN WALL STREET.

THE stock market was extremely dull last week and traders were unusually nervous. For some reason the opinion became general that a trust decision would be handed down Monday, March 20. This caused general uneasiness and kept buyers out of the market. Nobody had any good reason for picking this exact date for this decision to be made except that it was the last decision date before the court takes its annual spring recess. When it was announced during the forenoon Monday that no decision would be handed down the stock market at once awakened to comparative activity and prices advanced on the active issues several points. Even with this encouragement, however, there were only 373,979 shares sold.

NEW YORK.

	Mar. 13.	Mar. 20.	Shares Sold.		Mar. 13.	Mar. 20.	Shares Sold.
All. Ch.....	7⅞*	8*	250	Int. Met., pf.	51½*	54⅞	11,285
All. Ch., pf..	30½*	32½	700	Mackay Cos..	93½*	93½*	
Amal. Cop...	63⅛	64⅜	35,500	Mackay C., pf	75⅞	75⅞	650
Am. D. T....	20½*	20½*		Man. Elev...	138½*	138⅜*	100
Am. Loco...	38⅝	39¼	1,100	Met. St. Ry.	15*	15*	
Am. Loco. pf.	109¾*	109¼*	200	N.Y.&N.J.Tel.	139¼*	139½*	
Am. Tel. & C.	81*	81*		Steel com....	76⅞	79⅛	277,320
Am. T. & T.	145	146½	7,200	Steel, pfd....	118½	118⅞	4,900
B. R. T.....	76¾	77¾	9,930	W. U. T....	72¼*	72¾	2,100
Gen. Elec....	149	149½	1,400	West'h, com..	67*	68½	2,300
Int. Met.....	18⅜	19¾	5,487	West'h, pfd..	120*	120⅛*	100

PHILADELPHIA.

	Mar. 13.	Mar. 20.		Mar. 13.	Mar. 20.
Am. Rys.....	43½*	44	Phila. Elec.....	16¼	16¼
Elec. Co. of A.....	12⅛*	12⅛*	Phila. R. T.....	19⅝	19¾
Elec. St. B'ty.....	54¼	55½	Phila. Trac.....	86½*	84
E. S. B'ty., pfd....	30*	30*	Union Trac.....	47⅜	47¼

CHICAGO.

	Mar. 13.	Mar. 20.		Mar. 13.	Mar. 20.
Chi. City Ry.....	185	185*	Chi. Tel. Co.....	119½*	121*
Chi. Rs., Ser. 1.....	91½*	91½*	Met. El. Co.....	21½*	23*
Chi. Rs., Ser. 2.....	24½*	24*	Met. El., pfd.....	66*	69*
Com. Edison.....	122¾	128	Nat'l Car.....	118½	119⅞*
Chi. Subways.....	5	4⅝*	Nat'l Car, pfd.....	118½*	118½*

BOSTON.

	Mar. 13.	Mar. 20.		Mar. 13.	Mar. 20.
Am. T. & T.....	144⅞	146¼	Mex. Tel.....	4	3½
Cum. Tel.....	151¼	150*	Mex. Tel., pfd.....	6	6
Edison E., Ill.....	291	290*	N. E. Tel.....	145	143¼
Gen. Elec.....	149	149	W. T. & T.....	20*	20½*
Mass. E. Ry.....	17*	17½*	W. T. & T., pfd.....	93	93
Mass. E. Ry., pfd...	88	87¼			

*Last price quoted.
Shares sold for week, March 13 to March 18.

During the past week there has been little to chronicle in the Wall Street market beyond the remarkable display of apathy. The one feature of the week that was encouraging was the purchase by J. P. Morgan & Company and their Philadelphia associates of $13,850,000 of the bonds of the Public Service Corporation of New Jersey. This indicated that good bonds could still find a market and that the public was still investing. As a matter of fact, the bond market has been remarkable for several months, in view of the depressed condition of the stock market. This is taken to mean that the surplus wealth of the country, following the conservative business principles which have been instilled into the people within the past two years, is seeking gilt-edge investments rather than taking a chance in speculative ventures. The money market is still easy. Rates March 20 were: Call, 2@2⅜ per cent; ninety days, 2¾ per cent. The quotations in the table are those of the close March 20.

FINANCIAL NOTES.

Chicago City Railway Company.—For the year ended Jan. 31, 1911, the Chicago City Railway Company reports total receipts of $10,105,443. The total expenses are $8,596,508, leaving net earnings of $1,508,934, which compares with $863,318 for the preceding year. According to franchise requirement, 55 per cent of the net earnings go to the City of Chicago, and this amounts to $829,914 for the year. The company's 45 per cent amounts to $679,020. To this is added the 5 per cent interest on capital invested, allowed by the ordinance and carried as an expense, making the company's total income from operation for the year $2,673,960. Other income makes the total $3,113,140. Deducting interest on bonds outstanding, the company's net income for the year was $1,985,431. Dividends of 10 per cent on the capital stock, amounting to $1,800,000, were paid, leaving $185,431 carried as surplus. The showing is thus an excellent one both for the company and the city under the partnership arrangement which exists by ordinance. The report for the year contained the following reference to the distribution of the surplus accumulated in the year ended Jan. 31, 1910: "Adequate provision being contained in the settlement ordinance under which we are now operating, insuring the establishment of reserves sufficient to effectively maintain the present physical excellence of the property, there remained in the opinion of the directors no reason for longer conserving the large treasury surplus as of Jan. 31, 1910, which exceeded the par value of the capital stock to the amount of $1,319,891. Distribution of a portion of the surplus has therefore been made during the year by the payment of extra dividends aggregating 6 per cent on the capital stock." The directors elected are E. R. Bliss, L. A. Busby, Ira M. Cobe, R. B. Hamilton, T. E. Mitten, H. B. Riley and B. E. Sunny. Mr. Mitten was re-elected president.

Mississippi River Power Company.—There are now being offered to the public $15,000,000 first-mortgage 5 per cent sinking fund bonds of the Mississippi River Power Company, which is building an immense hydroelectric development at Keokuk, Ia. The offer that is being made is one $1,000 bond with two shares of common stock for $875. Work has already been begun upon the great dam across the Mississippi River at this point. It is claimed that the initial development will deliver 120,000 hp, and it is known that of this 60,000 has already been contracted for in St. Louis. The ultimate capacity of the plant is expected to be 200,000 hp. It is claimed that the company could have sold in St. Louis a much larger amount of energy, but refrained from doing so as other markets offered better prices. The company also recently sold $6,000,000 of preferred stock. The proceeds of this, together with the present bond sale, it is calculated, will complete the development up to the 120,000-hp stage. Of the above bond issue $3,500,000 was offered recently in London and immediately oversubscribed.

Des Moines City Railway Sold.—President G. B. Hippee announces the sale of the property of the Des Moines City Railway Company to N. W. Harris & Company, of Chicago. It is said that J. R. Harrigan, who has been manager of the Columbus, Delaware & Marion Railway Company, with headquarters in Columbus, Ohio, will become manager of the Des Moines property. The system, which has been in the courts for some time and which the city has contemplated buying, will be improved immediately. The property was valued at $4,500,000, which, however, included 52 per cent of the stock owned by N. W. Harris & Company before the present transfer. The buyers also control the company's bonds, and it is said that the actual cash transfer in the present sale was about $600,000.

Amalgamated Copper Company.—The Amalgamated Copper Company has finally completed its deal by which it absorbs the United Metals Selling Company. The price paid for the stock of the latter company was $246 a share, or $12,300,000 for the $5,000,000 outstanding. With this transaction go the 40,000 shares of the International Smelting & Refining Company, which was owned by the United Metals company. The United Metals Selling Company, which was organized some years ago by the Lewisohns and which has handled the output of the Amalgamated and quite a number of other prominent copper producers, has been a remarkably profitable organization. Its profits last year were close to $1,250,000, or 25 per cent on its capital stock.

Kansas Gas & Electric Company.—Brokers announce the sale of $300,000 worth of first-mortgage 5 per cent gold bonds of the Kansas Gas & Electric Company. These bonds are dated March 1, 1910, and are due March 1, 1922. The total amount authorized is $6,000,000, of which $1,939,000 is outstanding. The bonds are secured by a first mortgage on all the property of the company, which controls the commercial gas, electric lighting and electric power business in the cities of Wichita and Pittsburg, Kan. The net earnings of the company for the year ended Jan. 31, 1911, are reported as $279,534, the bond interest, including that on the bonds now offered, being $96,950. The bonds are offered at 97 and interest, netting 5⅜ per cent.

Public Service Corporation Bonds.—J. P. Morgan & Company, of New York, and Drexel & Company, of Philadelphia, have purchased from the Public Service Corporation of New Jersey $13,850,000 of its authorized issue of $50,000,000 5 per cent general-mortgage bonds. It is said that these bonds will be offered to the public at 94 and interest. A portion of the proceeds of this sale will be used to take up $4,000,000 notes which fall due Oct. 1, 1913, and the balance will go to pay for betterments and improvements. This sale will provide all the financing needed by the corporation for the next two years and is pronounced by President McCarter to be the most beneficial and far-reaching event that ever happened in the history of the company.

Terms for the Telephone Merger.—The terms of the proposed purchase of Independent systems in northern New York by the Friendship Telephone Company, of Syracuse, which is owned by the New York Telephone Company, have been announced. Reference to these negotiations was made in our last issue. The New York Telephone Company offers to buy the stocks and bonds of the Independent companies, the purchase price to be paid in cash. For the Rochester Telephone Company the price will be $50 a share and the first mortgage bonds will be purchased at par. The general-mortgage bonds will be purchased at 90. The stock of the Rochester, Syracuse & Utica Telephone Company will be purchased at $75 per share, the Utica Home Telephone Company at $50 a share and the bonds of this company at 95; the Onondaga Independent Telephone Company at $45 a share.

Cleveland Electric Illuminating Company Bonds.—Spencer Trask & Company are offering to the public $1,000,000 5 per cent bonds of the Cleveland Electric Illuminating Company at 102 and interest, yielding to the purchaser a trifle over 4.85 per cent. These bonds are a portion of an authorized issue of $30,000,000, of which $5,000,000 are now outstanding. In the statement accompanying the offer it is set forth that the company serves a population of 560,000 and operates under unlimited franchises. It is also stated that the company is now constructing a generating station on the shore of Lake Erie, built upon the unit plan, with an ultimate capacity of 100,000 hp, of which 40,000 hp will be developed this fall. Additional issues of bonds are limited to 80 per cent of the amounts actually expended on improvements and extensions.

United States Steel Annual Report.—The annual report for the year 1910 of the United States Steel Corporation, made public last week, showed gross sales of $703,961,424, an increase over the previous year of $57,579,173. The net earnings for the year were $141,054,754, as compared with $131,491,414 the previous year. The total surplus for the year, after charging off all of the usual items of sinking fund and depreciation and after charging to new reconstruction $26,000,000, amounted to $10,772,383. The total profit and loss surplus of the company is $164,143,158. The report shows that the appropriation made from the surplus net income of the company for the construction of the Gary plant up to the close of 1910 amounted to $65,000,000.

Philadelphia Company Stock Listed in Paris.—The first American stock ever admitted to trading on the Paris Bourse is the common issue of the Philadelphia Company, of Pittsburgh, 200,000 shares having been listed March 20. This admission was brought about through the efforts of Ladenburg, Thalmann & Company, the New York bankers. The stock is quoted on the Philadelphia exchange at about 109, and has paid 6 per cent dividends since 1902.

Commonwealth Edison Increases Dividend.—The executive committee of the board of directors of the Commonwealth Edison Company, of Chicago, decided last week to make the next quarterly dividend 1¾ per cent, thereby putting the stock on a 7 per cent basis instead of 6 per cent. This probably explains the recent sharp advance in the price of the stock. It is probable that from $3,000,000 to $5,000,000 new stock will be issued next fall.

DIVIDENDS.

American Cities Railway & Light Company, quarterly, preferred, 1½ per cent, payable April. 1.

American Telephone & Telegraph Company, quarterly, 2 per cent, payable April 15.

Bangor Railway & Electric Company, quarterly, 1¾ per cent, payable April 1.

Butte Electric & Power Company, quarterly, 1¾ per cent, payable April 1.

Chicago City Railway Company, quarterly, 2½ per cent, payable March 30.

Cincinnati & Suburban Bell Telephone Company, quarterly, 2 per cent, payable April 1.

Cincinnati Gas & Electric Company, quarterly, 1¼ per cent, payable April 1.

Cities Service Company, monthly, preferred, one-half of 1 per cent; common, ¼ per cent, payable April 1.

Consolidated Gas, Electric Light & Power Company, Baltimore, quarterly, common, 1¼ per cent; preferred, semi-annual, 3 per cent, both payable April 1.

Cumberland Telephone & Telegraph Company, quarterly, 2 per cent, payable April 1.

Duluth Edison Electric Company, quarterly, 1½ per cent, payable April 1.

Louisville (Ky.) Home Telephone Company, 1½ per cent, payable April 1.

Manila Electric Railway & Light Corporation, quarterly, 1¼ per cent, payable April 1.

Massachusetts Lighting Companies, quarterly, 1¾ per cent, payable April 15.

Narragansett Electric Lighting Company, quarterly, 1 per cent, payable April 1.

Nebraska Telephone Company, quarterly, 1½ per cent, payable April 10.

Niagara Falls Power Company, 2 per cent, payable April 15.

Norfolk & Portsmouth Traction Company, quarterly, preferred, 1¼ per cent, payable April 10.

Pacific Telegraph & Telephone Company, quarterly, preferred, 1½ per cent, payable April 15.

Rubber Goods Manufacturing Company, quarterly, 2 per cent, payable March 25.

Sao Paulo Tramway, Light & Power Company, quarterly, 2½ per cent, payable April 1.

St. Joseph (Mo.) Railway, Light, Heat & Power Company, quarterly, preferred, 1¼ per cent, payable April 1.

Stark Electric Railroad Company, Alliance, Ohio, quarterly, ¾ per cent, payable April 1.

Syracuse Rapid Transit Company, quarterly, preferred, 1½ per cent, payable April 1.

Tri-City Railway & Light Company, Davenport, Ia., quarterly, preferred, 1½ per cent, payable April 1.

Union Switch & Signal Company, quarterly, preferred, 3 per cent; common, 3 per cent, both payable April 10.

Union Traction Company of Indiana, semi-annual, 2½ per cent, payable April 1.

United Traction & Electric Company, of Providence, quarterly, 1¼ per cent, payable April 1.

Western Electric Company, quarterly, 2 per cent, payable March 31.

REPORTS OF EARNINGS.

Period.		Gross Earnings.	Operating Expenses.	Net Earnings.	Fixed Charges.	Net Surplus.
AMERICAN LIGHT & TRACTION COMPANY.						
February	1911	$358,908	$8,942	$349,966	.....	.....
"	1910	311,549	9,285	302,264	.....	.....
COLORADO TELEPHONE COMPANY.						
Year.	1910	$3,159,417	$2,472,092	$687,325	$595,000	$92,325
"	1909	2,907,726	2,226,466	681,260	595,000	86,260
DALLAS ELECTRIC CORPORATION.						
January,	1911	$139,374	$82,192	$57,182	$27,423	$29,759
"	1910	118,721	80,752	37,969	26,407	11,562
DENVER CITY TRAMWAY COMPANY.						
Year,	1910	$3,595,157	$1,859,251	$1,735,906	$1,065,833	$670,072
"	1909	3,374,133	1,678,834	1,695,299	991,940	703,359
DOMINION POWER & TRANSMISSION COMPANY.						
Year,	1910	$1,922,398	$1,061,075	$861,323	$327,566	$533,757
"	1909	1,691,696	963,949	727,747	332,774	394,973
ELECTRIC STORAGE BATTERY COMPANY.						
Year,	1910	$1,314,223	$442,650	$1,120,012	$649,964	$470,048
"	1909	1,218,483	384,021	933,492	528,092	405,398
GALVESTON-HOUSTON ELECTRIC COMPANY.						
January,	1911	$139,374	$82,192	$57,182	$27,423	$29,759
"	1910	118,721	80,752	37,969	26,407	11,562
INDIANA UNION TRACTION COMPANY.						
Year,	1910	$2,364,628	$1,239,314	$1,125,314	$1,023,574	$101,740
"	1909	2,102,019	1,118,429	989,590	948,756	40,834
KANSAS CITY RAILWAY & LIGHT COMPANY.						
February,	1911	$599,951	$321,764	$278,187	$190,263	$87,924
"	1910	553,543	286,727	266,815	164,810	102,005
MICHIGAN STATE TELEPHONE COMPANY.						
Year,	1910	$4,225,174	$3,280,420	$944,754	$258,039	$507,734
"	1909	3,819,630	2,964,115	885,515	240,727	381,991
MILWAUKEE ELECTRIC RAILWAY & LIGHT COMPANY.						
Year,	1910	$6,428,710	$4,382,611	$2,046,099	$1,278,719	$767,380
"	1911	5,709,946	3,680,420	2,029,526	1,257,974	771,552
MONTREAL STREET RAILWAY COMPANY.						
January,	1911	$370,124	$239,982	$130,142	$39,155	$90,986
"	1910	325,621	205,060	120,561	35,690	84,871
ROCKY MOUNTAIN BELL TELEPHONE COMPANY.						
Year,	1910	$2,053,502	$1,407,887	$645,615	$469,283	$176,332
"	1909	1,855,689	1,332,467	523,222	441,655	81,568
UNION ELECTRIC LIGHT & POWER COMPANY OF ST. LOUIS.						
Year,	1910	$3,371,520	$1,767,211	$1,604,309	$823,341	$780,967
"	1909	3,085,614	1,503,034	1,503,034	834,204	748,376
UNITED RAILWAYS OF ST. LOUIS.						
January,	1911	$920,919	$634,569	$286,340	$231,560	$58,916
"	1910	881,961	628,145	253,815	233,624	24,012
WESTERN TELEPHONE & TELEGRAPH COMPANY.						
Year,	1910	$2,294,946	$1,343,026	$926,405	$800,000	$126,405
"	1909	2,169,641	1,285,741	861,471	800,000	61,471

General News

Construction News.

VALDEZ, ALASKA.—Announcement has been made by the Alaska Water, Light & Telephone Company of extensive improvements to be made to its system this summer, including the erection of new transmission line, increasing the voltage from 2300 to 13,000 and other improvements.

TEMPE, ARIZ.—Two propositions have been submitted to the drainage committee of the Tempe Canal Company by Julius Beeman, of San Francisco, Cal., hydraulic engineer. One is to install two pumping plants complete, including engine and pump, at an estimated cost of $12,000 for each pump, other work extra; the second proposition is to install a generating plant, electricity to be transmitted to the pumping plants, to cost about $44,000. The second proposition seems to be favored.

HARRISBURG, ARK.—Morris Hayutin, of Harrisburg, Ark., is reported to have purchased the property of the Harrisburg Electric Light & Power Company. It is understood that the new owner will make extensive improvements to the plant.

HALF MOON BAY, CAL.—Application has been made to the Board of Supervisors by Benjamin Cunhaz for a franchise to install an electric light plant in Half Moon Bay.

KENNETT, CAL.—The transmission lines of the Sacramento Valley Power Company will be extended from Redding to Kennett within the next few months. The company has placed contracts for furnishing power which call for delivery by Sept. 25. The cost of extending the lines is estimated at about $50,000. It is said that the company will also extend its lines to Coram, eighteen miles north of Redding.

LOS ANGELES, CAL.—The Los Angeles Gas & Electric Company is reported to be contemplating extending its system to Altadena

LOS ANGELES, CAL.—A meeting of the stockholders of the Pacific Light & Power Company will be held May 8 for the purpose of considering the question of increasing the bonded indebtedness of the corporation by $35,000,000.

MORGAN HILL, CAL.—The Board of Trustees has granted the Coast Counties Light & Power Company a franchise to erect and maintain transmission lines over and across the highways in the town of Morgan Hill for the distribution of electricity.

OAKLAND, CAL.—The City Council has granted the Southern Pacific Company a franchise to operate a railway on Seventh Street for a term of thirty-five years. Under the terms of the franchise the company is to pay the city the sum of $5,000 annually for the first fifteen years and thereafter $8,500 per annum; to pave Seventh Street at a cost of $200,000 and also to light the street at a cost approximately of $9,000 per year.

PASO ROBLES, CAL.—The Board of Trustees are reported to be contemplating calling a special election to vote on the proposition to issue bonds to acquire an electric light and water-works plant, to be owned and operated by the municipality.

QUINCY, CAL.—Deeds transferring 875,000 miners inches of water in Feather River and Butte Creek to the Great Western Power Company have recently been filed.

REDDING, CAL.—The Board of Supervisors of Shasta County has passed a resolution authorizing the sale of the franchise applied for by the Siskiyou Electric Light & Power Company to erect transmission lines, for transmitting electricity for lamps and motors on the highways of Shasta County, to be sold on May 8. The franchise was applied for by J. W. Churchill and Alex. Posborough.

SAN BERNARDINO, CAL.—The Chuckawalla Development Company is making investigations on the Colorado River with a view of locating a dam site. The company is planning to develop water-power to generate electricity which will be supplied to settlers in the Chuckawalla Valley to operate pumps for irrigating purposes. T. M. Teague is president of the company.

SAN FRANCISCO, CAL.—The San Francisco Gas & Electric Company is contemplating installing a steam-heating service, and will soon apply to the Board of Supervisors for permission to lay pipes for same.

SAN FRANCISCO, CAL.—The finance committee of the Board of Supervisors has decided to recommend granting the request of the Board of Public Works for the appropriation of $300,000 for the installation of a power plant and other construction work in the new city and county hospital. The committee will also recommend an appropriation of $100,000 for furnishing ornamental metal work, decorations, lighting fixtures, plastering, etc., for the Hall of Justice and the new county jail.

VALLEJO, CAL.—The City Trustees have granted the National Electric Company a franchise to enter Vallejo and extend its line along the water to a connection with the San Francisco end.

WILLOWS, CAL.—The Northern California Power Company is contemplating extensive additions to its system in Willows and is planning to erect a transmission line from Hamilton to Princeton and thence to Williams and Arbuckle, work on which will begin at once. The company expects to be ready to deliver electricity in that territory within ninety days.

YREKA, CAL.—The Siskiyou Electric Light & Power Company has begun work on the construction of a large dam at the head of Ward's Canyon, sixteen miles above Hornbrook, on the Klamath River. The dam will b 250 ft. long and 90 ft. high and will develop 20,000 hp. Work will soon commence on the erection of the transmission lines to Klamath Falls and to the Butte Creek Valley.

BOULDER, COL.—Plans are being prepared by the Highland Power Company for the construction of a high-head hydroelectric power plant. H. von Schon, Wayne County Savings Bank Building, Detroit, Mich., is consulting engineer.

DENVER, COL.—Plans have been prepared by the Central Colorado Power Company for extensions to its transmission lines, covering a large portion of the central section of the State, which will involve an expenditure of between $300,000 and $400,000. The new transmission lines will extend to Alma, Fairplay and surrounding territory, to the Gilpin County mining district, toward Rollinsville and other sections, which at present have not electrical service. The new transmission lines will cost about $1,000 per mile.

DENVER, COL.—Supervisor George J. Kindel has authorized the city engineer to prepare plans and estimates for an electric light plant to light the city, securing energy from the falls at Chesman dam. This plan depends, of course, on the city's acquiring the plant of the Denver Union Water Company. At present it costs the City of Denver $185,000 annually for electric lamps, which are supplied by the Denver Gas & Electric Company. The question of the city undertaking the project is quite remote, as the water cases are in the United States courts. The citizens have voted to build an independent plant. If the city should acquire Cheesman Lake with the water-works plant the water power may be developed.

FORT COLLINS, COL.—James F. Vandewark, president of the Riverside Ice & Storage Company, and Jesse R. Wood, secretary of the Chamber of Commerce, have announced that they will apply to the City Council for a franchise to operate an electric light plant in Fort Collins. The promotors of the new plant propose to develop the water-power of Poudre River to generate electricity. A clause will be inserted in the franchise giving the city an opportunity to purchase the plant at intervals of five years. If the franchise is granted the plant will be built entirely by local capital.

GEORGETOWN, COL.—A contract has been awarded by W. E. Renshaw, manager of the Gem Electric Company, of Idaho Springs, Col., to George Keyes to raise the dam at White's Lake 5 ft., which will provide for storage of water for increasing the output of the American Sisters electric plant to 1700 hp. The American Sisters plant was purchased a few months ago by the Gem Electric Company. It is understood that the power station will be enlarged and additional machinery installed. The Gem company now controls four plants, two at Idaho Springs, one at Fall River and the other at Georgetown. It is proposed to connect up all the plants and supply electricity in all cities and towns in Clear Creek and Gilpin Counties. Mr. Renshaw, it is understood, will apply for franchises in both Georgetown and Silver Plume, and if granted will supply electricity to both towns within six months. The company also proposes to supply electricity for the mines in this vicinity.

NEW HAVEN, CONN.—The Connecticut Company is preparing plans for the construction of an extension to Staffordville, a distance of about four miles.

SAYBROOK, CONN.—The Shore Line Electric Railway Company is planning to build an extension to connect Guilford and New Haven, via North Branford, Totoket and Foxen during the year, which will require the construction of about fourteen miles of track.

SOUTHINGTON, CONN.—It is reported that plans are being prepared by the Peck, Stow & Wilcox Company, of Cleveland, Ohio, for the construction of a new plant in Southington, Conn., which will include the erection of several buildings and a power plant. An engine and generator having a rating of 750 hp will be purchased.

WILMINGTON, DEL.—The People's Railway Company is reported to be negotiating with the McCall Ferry Power Company, McCall Ferry, Pa., to supply electricity to operate the railway company's system. Announcement has been made by R. W. Creek, general manager of the People's Railway Company, that the company will supply electricity for lamps and motors in Wilmington as soon as arrangements are completed. The Wilmington & Philadelphia Traction Company now controls the entire electrical business in this city.

WASHINGTON, D. C.—Bids will be received until April 4 at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., for furnishing at the various navy yards and naval stations supplies as follows: Boston, Mass., Schedule 3422—17,000 lb. cast steel crucible wire; Schedule 3425—40,000 ft. steel enameled conduit. Brooklyn, N. Y., Schedule 3425—87,000 lb. condenser tubes, etc. Mare Island, Cal., Schedule 3392—2485 lb. hot rolled sheet copper; Schedule 3368—one 10-

ton, three-motor electric jib crane. Applications for proposals should designate the schedules desired by number.

JACKSONVILLE, FLA.—Arrangements are being made by the Stone & Webster Corporation for extensive improvements to the properties of the Jacksonville Electric Company, which will involve an expenditure of about $1,000,000 and include the construction and equipment of a new power house at a cost of about $525,000, addition to car barn, ten new cars and double tracking some of the most important street car lines in the city and other improvements.

CUTHBERT, GA.—The Cotton Belt Telephone Company has filed application with the State Railroad Commission asking for permission to issue $50,000 in bonds, the proceeds to be used for improvements and extensions to its system.

McDONOUGH, GA.—The City Council has engaged J. B. McCrary & Company, of Atlanta, Ga., to prepare plans for the installation of an electric light system in McDonough.

SAVANNAH, GA.—The capital stock of the Savannah Lighting Company has been increased from $500,000 to $2,000,000.

BELLEVILLE, ILL.—The Belleville & Mascoutah Traction Company, of Belleville, Ill., is contemplating extensions to its system, which will require the construction of about eleven miles of track.

CLINTON, ILL.—The National Telephone & Electric Company has applied to the City Council for a franchise to place its wires underground in this city. The company proposes to make improvements to its system, involving an expenditure of about $50,000, of which $15,000 will be used for the installation of a new switchboard and central energy system.

EAST ST. LOUIS, ILL.—The City Council has passed an ordinance providing for the installation of about 120 new arc lamps in the downtown district of the city.

GRIGGSVILLE, ILL.—The Union Electric Service Company is reported to have been granted a franchise by the City Council to install and operate an electric light plant in Griggsville. The franchise is for a term of twenty-five years.

JOLIET, ILL.—The Sanitary District of Chicago has applied to the Council for a franchise to erect transmission lines in Joliet. The company proposes to supply electricity to several large manufacturing plants in this town.

SPRINGFIELD, ILL.—The Sterling Business Men's Association has appointed a committee to secure estimates of the cost of installing a boulevard lighting system. Charles Stecker, A. B. Ahrens and M. C. Wharfield are members of the committee.

WAUKEGAN, ILL.—Plans are being prepared by the North Shore Electric Company for extensive additions to its Waukegan plant, increasing the output from 1000 hp to 1500 hp. This plant supplies the entire electrical service in Lake and McHenry Counties.

COLUMBUS, IND.—Plans have been completed by the Indianapolis, Columbus & Southern Traction Company for the construction of a canal seven miles long, 6 ft. deep and 60 ft. wide, which will furnish power to generate electricity to operate its cars between Indianapolis and Seymour for at least six months in the year. The company will build a power house north of here, and when completed the plants in Edinburg and Greenwood will be closed down. The cost of the canal and power house is estimated at about $200,000. The canal will be used as a pleasure water course.

EVANSVILLE, IND.—Arrangements are being made for the construction of an addition to the Evansville Gas & Electric Light Company's electric power station located at Division and Main Streets, to cost about $148,000, work on which will begin about April 1. The new equipment will include a new 2000-kw turbo-generator set, and provision will be made for another battery of boilers in the new extension.

GARRETT, IND.—The City Council is reported to be considering the installation of an improved system of street illumination in connection with enlarging the municipal electric light plant.

KOKOMO, IND.—The Haines Auto Company is planning to rebuild its plant, which was recently destroyed by fire. The new plant will be equipped for electrical operation. The company has increased its capital stock from $600,000 to $800,000 and collected $240,000 insurance on its plant.

PENDLETON, IND.—The bonds issued for the erection of a municipal electric light plant in Pendleton have been purchased by the Pendleton Banking Company.

WESTPOINT, IND.—The Westpoint Co-operative Telephone Company has increased its capital stock by $6,000. The company proposes to enlarge and make improvements to its property.

ADAIR, IA.—The contract for the construction of the combined electric light plant and water-works system in Adair, Ia., has been awarded to the Des Moines Bridge & Iron Company, of Des Moines, Ia., for $28,469.

ATLANTIC, IA.—The contract for improvements to the municipal electric light and water plant has been awarded to James Borlanger & Co., of Omaha, Neb., at $43,000, the company to take over the old equipment.

CEDAR RAPIDS, IA.—A site has been selected for the large power-house to be erected in Cedar Rapids by the Rock Island Railway Company, to cost about $50,000.

MANCHESTER, IA.—The proposition to grant a franchise to Joseph Hutchinson to install an electric light plant in Manchester will be submitted to a vote on March 27.

MANCHESTER, IA.—It is reported that the Manchester Light, Heat & Power Company is planning to enlarge its electric power plant, which will include the installation of an engine and generator.

REDFIELD, IA.—The Town Council is considering the question of installing a municipal electric light plant and water-works system at a cost of about $15,000.

ROLAND, IA.—The town of Roland is reported to be contemplating the installation of a municipal electric light plant, for which plans are now prepared. The cost of the plant is estimated at about $8,000.

WATERLOO, IA.—Preparations are being made by the Citizens' Gas & Electric Company, of Waterloo, Ia., for the erection of new power stations, to be used when the wires are placed in underground conduits in the business district. A site on Jefferson Street has been selected for one and two sites are being considered in East Waterloo.

ARKANSAS CITY, KAN.—The City Council is reported to be considering the question of installing an electric light system in Arkansas City.

COLDWATER, KAN.—Sealed bids will be received by W. F. Baker, city clerk, until March 30 for furnishing material and constructing water-works and electric light system in Coldwater, Kan. Plans and specifications may be seen at the office of the J. S. Worley Company, Reliance Building, Kansas City, Mo., which has charge of the engineering work. J. Knecht is Mayor.

BOWLING GREEN, KY.—The Board of Public Works is contemplating asking bids for the installation of a new engine for the municipal electric light plant and the purchase of a new pump for the water-works system, to cost about $8,000.

JEFFERSONTOWN, KY.—The Jeffersontown Commercial Club is interested in a project to establish an electric light plant in Jeffersontown.

LOUISVILLE, KY.—The Board of Education has authorized twenty of the school buildings in Louisville to be wired and equipped for electric lamps at a cost of $14,490.

LOUISVILLE, KY.—The Kentucky Electric Company, of Louisville, has purchased a site, on which it proposes to erect its new power plant, at a cost of about $1,000,000.

ALEXANDRIA, LA.—It is reported that the Alexandria Street Railways Company's system has been taken over by J. A. White and others. It is understood that the company will be reorganized and improvements made by the new owners.

SHREVEPORT, LA.—The City Commissioners have submitted an ultimatum to the Shreveport Gas, Electric Light & Power Company asking for a reduction in the price of electricity for private consumers to 8 cents per kw-hour and $60 per lamp per year for street arc lamps for a term of six years. Unless the company agrees to these terms steps will be taken immediately to issue $250,000 in bonds for the establishment of a municipal electric plant. The company has offered to reduce the price of electricity to 9 cents per kw-hour to private consumers and to furnish street arc lamps at $69 each per year on a ten-year contract.

KENSINGTON, MD.—The Potomac Electric Company, of Washington, D. C., has applied to the Town Council for a franchise to supply electricity for lamps and motors. The franchise is for a term of thirty-five years and exempts the company from taxation for ten years,, after which it is to pay a tax of 1 per cent of its gross receipts.

COLRAIN, MASS.—The Colrain Electric Light & Power Company has applied to the Massachusetts Gas & Electric Light Commission for authority to consolidate with the Greenfield Electric Light & Power Company, of Greenfield, Mass., on the basis of an exchange of stock share for share.

GARDNER, MASS.—The Massachusetts State Board of Gas and Electric Light Commissioners has authorized the Gardner Electric Light Company to issue $105,000 in additional capital stock, the proceeds to be used to retire notes and pay for construction and enlargements to plants.

HUDSON, MASS.—Preparations are being made by George A. Brothers, superintendent of the municipal electric light plant, to substitute tungsten lamps for the arc lamps now in use.

LOWELL, MASS.—The Board of Aldermen has voted to authorize the inspector of buildings to secure estimates of the cost of installing an electric light plant in the basement of the city hall building to supply electricity for lighting the city hall, the Memorial Building and other public buildings located in that vicinity.

MALDEN, MASS.—The Malden Electric Company has purchased the lot adjoining its property, with a view of enlarging its plant.

SHELBURNE FALLS, MASS.—The Shelburne Falls Electric Light & Power Company has petitioned the Massachusetts Gas & Electric Light Commission for permission to issue additional capital stock to the amount of $175,000 per value, the proceeds to be used for the purchase of plants of the Colrain and Shelburne Falls companies and to pay for the cost of improvements to its system.

SPRINGFIELD, MASS.—Sealed proposals will be received by the Municipal Building Commission, Municipal Building, Springfield, Mass., until March 24 for furnishing equipment for power plant and electric wiring for the power plant to be erected by the City of Springfield between Court and Pychon Streets. Copies of plans and specifications may be seen at the Municipal Building and at the office of Kirkham & Parlett, architects, Carr Building, Springfield, Mass., or at the office of Hollis,

French & Allen Hubbard, Albany Building, Boston, Mass., or may be obtained on application to the latter.

SWANSEA, MASS.—The town of Swansea has voted to appropriate $1,000 a year for forty electric street lamps for a term of five years, and the Selectmen were authorized to execute a contract with the Fall River Electric Light Company to supply the service.

KALAMAZOO, MICH.—The City Council has decided to make improvements to the municipal electric light system. It has not yet been decided whether the city will build an entire new plant or purchase energy from a private corporation. The Council committee has recommended the installation of an entire new plant at a cost of about $69,231, which would provide for the maintenance of 2000 arc lamps. The present plant supplies 400 arc lamps at a cost of $45 per lamp per year.

MILFORD, MICH.—F. S. Hubbell, owner of the Milford electric light works, has purchased the available water rights on the Huron River in Milford, and will begin work on the construction of a new power house at once. C. C. Sherk is superintendent.

BUFFALO, MINN.—A franchise has been granted to J. A. Bonner to construct and operate an electric light plant in Buffalo for a term of twenty years.

EVELETH, MINN.—Bids will be received at the office of the city clerk, Eveleth, Minn., until April 4 for furnishing and installing an ornamental street-lighting system on six blocks of Grant Avenue, according to plans and specifications now on file in the above office. It is estimated that about forty-six five-lamp posts will be required. D. P. McIntyre is city clerk.

GLENWOOD, MINN.—It is reported that a petition has been presented to the Village Council asking it to grant a franchise to parties who will construct a new electric plant, or to build a municipal electric plant. The service is now furnished by the Glenwood Milling Company and is not at all satisfactory.

MANKATO, MINN.—The Spooner bill, providing $40,000 for investigating the feasibility of a canal system from the Lake of the Woods to Mankato, thence to Duluth, through Minneapolis and St. Paul, Minn., taking advantage of the Minnesota and Mississippi Rivers and contemplating the construction of large dams for water-power purposes, as well as a 12-ft. barge canal, has been recommended for passage by the Senate committee on drainage.

MINNEAPOLIS, MINN.—The Segerstrom Piano Manufacturing Company, of Minneapolis, Minn., it is reported, is contemplating the construction of a new factory building, having a floor space of about 50,000 sq. ft. It is understood that considerable new equipment will be purchased. The plant will be equipped for electric motor drive.

WASECA, MINN.—At an election to be held in April the proposition to issue $15,000 in bonds, the proceeds to be used for improvements to the municipal electric light plant and water-works system, will be submitted to a vote.

GULFPORT, MISS.—The Supervisors of Harrison County have granted the Gulfport & Mississippi Coast Traction Company, of Gulfport, Miss., a franchise to construct and operate transmission lines over the county road between Gulfport and Biloxi, a distance of fifteen miles. The company will erect a three-phase, 18,000-volt transmission system through Handsboro and into Biloxi, Miss. The company has been granted a franchise by the City Council in Handsboro to construct and operate an electric light and power system in and through that city.

NEWTON, MISS.—At an election held March 6 the proposition to issue $11,000 in bonds, the proceeds to be used for the installation of an electric light plant, was carried. X. A. Kramer, of Magnolia, Miss., is consulting engineer.

COLUMBIA, MO.—The Water and Light Committee has been authorized to advertise for bids for the construction of a new power house and equipment, including chimney, boiler plant, stokers and breeching, coal and ash-handling machinery, steam turbo-generator set, exciter and switchboard, condenser and cooling tower; two motor-driven centrifugal service pumps, two boiler feed pumps, feed water heater, pipe work and wiring. The cost of the work is estimated at $69,600. John S. Bicknell is city clerk.

KANSAS CITY, MO.—Sealed bids will be received by Leo M. Gilday, County Clerk, until March 31 for furnishing one automatic cut-off steam engine and one 200-kw, 220-volt, direct-current generator for direct connection to engine, in accordance with plans and specifications.

ST. LOUIS, MO.—The Board of Public Works is reported to be considering the question of installing an electric plant in the basement of the city hall, to cost about $70,000.

ST. LOUIS, MO.—The Hempstead Structural Steel Company, of St. Louis, Mo., it is reported, is constructing a large bridge shop, which will be equipped for electric motor drive.

CHESTER, MONT.—At a special election held recently the citizens voted in favor of granting franchises for the installation of electric light, water works and telephone systems in Chester.

FORT OMAHA, NEB.—Sealed proposals will be received until April 10 at the office of the constructing quartermaster, Fort Omaha, Neb., for construction of an extension to the electric lighting system at Fort Omaha. For further information apply to Captain W. L. Clarke, constructing quartermaster.

GORDON, NEB.—It is reported that bonds have been voted for the installation of an electric light plant, water-works and sewer systems.

OMAHA, NEB.—Bids will be received by J. F. Burgess, secretary of the Board of Education, Omaha, Neb., until April 1 for construction of north and west wings and power-plant building of the Omaha High School and for the necessary alterations and connections with the present wings, including heating, ventilating, power apparatus, plumbing, electric wiring, etc. Plans and specifications can be obtained from the secretary of the board or from John Latenser, 622 Bee Building, Omaha, Neb.

ELKO, NEV.—Preparations are being made by the Thousand Springs Power Company, of Idaho, to supply electricity to the mining camp of Jarbridge, in the northern part of Elko County. Work will soon begin on the erection of the transmission line to the mining camp. W. D. Reynolds is president of the Thousand Springs Power Company.

ROSWELL, N. M.—The directors of the Rio Hondo Water Users' Association of Roswell are reported to have secured a government loan of $60,000 for the construction of a concrete irrigation system which will include sixteen miles of ditches and canals, together with reservoirs, power plants and pumping stations.

ALBANY, N. Y.—Sealed proposals will be received by the Secretary of the Trustees of Public Buildings, Executive Chamber, Capitol, Albany, N. Y., until April 20 for equipment of the Capitol power house and conduits, located on the corner of Sheridan Avenue and North Hawk Street, Albany. Separate proposals will be required as follows: 1. For steam power equipment. 2. For electrical equipment. Plans and specifications and blank forms of proposals may be obtained at the office of the State Architect, Albany, N. Y., after March 25. A deposit of $25 will be required for each set of plans. Plans and specifications will be on file after March 25 at the offices of Nygren, Tenney & Ohmes, 87 Nassau Street, New York, N. Y.; C. E. Knox, 76 William Street, New York, N. Y., and at the office of Franklin B. Ware, State Architect, Albany, N. Y.

BUFFALO, N. Y.—The Lehigh Valley Railroad Company is reported to be planning to build new iron and coal docks at its Tiff farm terminal at Buffalo to cost about $500,000. The company proposes to develop its coal and ore-handling facilities and will equip its new dock with unloaders, costing $40,000 each, which will be operated by electricity.

GENEVA, N. Y.—The Public Service Commission, Second District, has given its approval to the consolidation of the Geneva-Seneca Electric Company, of Geneva, and the Wayne County Gas & Electric Company, of Newark, N. Y., under the name of the Central New York Gas & Electric Company, to operate in Wayne and Ontario counties. The company is authorized to purchase the plant of J. Q. Howe's Sons, at Phelps, for $15,000. Permission has been given the company to issue $150,000 in capital stock and $650,000 in bonds, under a mortgage for $2,000,000, and $150,000 in five-year notes, the bonds to be sold at not less than 85 and the notes at par.

LONG ISLAND CITY, N. Y.—Bids will be received by C. B. J. Snyder, superintendent of school buildings, Department of Education, corner of Park Avenue and Fifty-ninth Street, New York, N. Y., until March 27 for installing additional electric equipment and making alterations in Public School 7, on Van Alst Avenue, Long Island City, N. Y. Blank forms, plans and specifications may be seen at the above office and at the branch office, 69 Broadway, Flushing, N. Y.

RICHVILLE, N. Y.—The question of lighting the streets of the village is reported to be under consideration.

WEST SAND LAKE, N. Y.—The Wynantskill Hydro-Electric Company, recently incorporated with a capital stock of $75,000, is planning to develop the water-power of the Wynantskill River at West Sand Lake to supply electricity for lamps and motors to the farmers in this section. It is proposed to erect a power house near the site of the present Troy & New England Railway generating station and install a steam plant for use during the low water period. The cost of the plant is estimated at about $10,000, work on which will begin about April 1. The company expects to be able to supply electricity in Averill Park and West Sand Lake by June 1.

ROCKY MOUNT, N. C.—W. H. Powell, of Scotland Neck, N. C., and Robert Donald, of Tarnore, N. C., representing Baltimore capitalists, are seeking a franchise to construct and operate an electric railway in Rocky Mount.

TIOGA, N. D.—It is reported that a company has been organized in Tioga to install an electric light plant.

ASHTABULA, OHIO.—The City Council is reported to have appropriated $10,000 for improvements to the municipal electric light plant, which will double the present output of the plant. Two boilers will be installed at a cost of about $6,300, bids for which will be called for in the near future.

CINCINNATI, OHIO.—Bids will be received until April 3 for the erection of a sterilization plant and turbine station at the California water-works station, to cost about $20,000. Robert Laidlaw is superintendent of water works.

COLUMBUS, OHIO.—Plans are being considered for replacing the arch-lighting system on High Street with the cluster-lamp system.

HAMILTON, OHIO.—The Miami Power Company, recently incorporated, is planning to erect a hydroelectric power plant on the site of the old Chatfield & Woods paper mill at Woodsdale. The proposed plant will cost about $500,000 and about 5000 hp will be developed. Electricity generated at the plant will be transmitted to Hamilton, Middletown, Miamisburg and Franklin. The incorporators are: H. L. Hanley, J. W. Durfee, of Chicago, Ill.; W. D. James, of Detroit, Mich.; William Bergen and John Reif, of Overpeck, Ohio.

KENTON, OHIO.—The Kenton Gas & Electric Company, of Kenton, Ohio, has engaged the Central Station Development Company, of Cleveland, Ohio, to prepare plans for a new generating plant, including the rehabilitation of the present lighting system. The output of the new plant will be about 1000 kw.

MARION, OHIO.—The capital stock of the Marion County Telephone Company has been increased from $150,000 to $300,000.

HOLLIS, OKLA.—T. G. Benge, who was recently granted a franchise to install an electric light plant in Hollis, will soon begin work on installation of same.

MUSKOGEE, OKLA.—It is reported that the Monticello Company, recently incorporated with a capital stock of $100,000, proposes to supply electricity and water in connection with the electric railway from Muskogee to Fort Gibson, Okla. Thomas P. Smith, Lillie E. Haskell and W. R. Eaton are interested in the company.

WOODWARD, OKLA.—The Council is reported to be considering the question of issuing $30,000 in bonds, the proceeds to be used for the installation of a municipal electric light plant.

BAKER CITY, ORE.—The City Council has authorized the city engineer to prepare plans for the construction of a pipe line from Ely Creek to Salmon Creek in connection with the proposed municipal electric light plant.

SALEM, ORE.—The Capital Trust Company, of Portland, Ore., has applied to the City Council for permission to erect electric transmission wires across the bridge at the foot of Center Street to supply electricity to a large tract of land which the company is opening up in that section for lighting purposes.

THE DALLES, ORE.—The Dalles Water Commissioners are contemplating improvements to the present water system which will involve an expenditure of about $20,000. Plans are also under consideration by the Commissioners for installing a power plant in connection with the water they control to supply electricity for lamps and motors in this city.

PANAMA.—Bids will be received at the office of the General Purchasing Officer, Isthmian Canal Commission, Washington, D. C., until April 14 for furnishing dynamite blasting caps, detonators, safety fuse, insulating tape, connecting and lead wire. Blanks and general information relating to this circular (No. 626) may be obtained from the above office or at the offices of the assistant purchasing agents, 24 State Street, New York, N. Y.; 614 Whitney-Central Building, New Orleans, La., and 1086 North Point Street, San Francisco, Cal. Captain F. C. Boggs is general purchasing officer.

BRISTOL, PA.—The Pennsylvania Railroad Company, it is reported, is contemplating the construction of an electric power plant in Bristol to supply electricity for lamps for its elevated line.

BUTLER, PA.—It is reported that options have been taken on about 1000 acres of land along Slippery Rock Creek, between Kennedy's Mills and McConnell's Mills, just west of Portersville, where it is said a large power plant will be erected. It is understood that the company proposes to supply electricity for lamps and motors in New Castle and Ellwood City.

CLEARFIELD, PA.—The Greene Heat, Light & Power Company has filed amendments to its charter increasing its capital stock from $10,000 to $15,000.

HAMBURG, PA.—The local electric light plant is reported to have been destroyed by fire, causing a loss of about $10,000.

HERSHEY, PA.—Plans are being considered by the Hummelstown & Campbellstown Street Railway Company for the construction of a power plant in Lebanon.

INDIANA, PA.—The Indiana County Street Railways Company is reported to have decided to erect a power plant at Two Lick, which, it is said, will be a duplicate of the present plant located there.

READING, PA.—Arrangements are being made by S. S. Miller, of Reading, for the erection of a new mill 36 ft. x 120 ft., three stories high, for the manufacture of men's hosiery. A separate power-house will be erected, which will be equipped with an engine and boiler of 100-hp and generator to supply electricity for lighting purposes.

SUNBURY, PA.—Plans are being prepared by the Middle Creek Electric Company for extending its service to other towns, the most important of which are Middleburg and Lewisburg. The company has submitted a proposition to the Middleburg Light, Heat & Power Company offering to supply electricity from the power plant at Selinsgrove. The transmission line is to be erected by the Middleburg company. J. Harris Leuker is president of the Middle Creek Electric Company.

NEWBERRY, S. C.—The Southern Power Company has applied to the City Council for a franchise to erect an electric system in Newberry.

WALTERBORO, S. C.—The question of installing an electric light plant in Walterboro is reported to be under consideration. John D. Glover, G. C. Brown, T. J. Blanchard and others are interested in the project.

LEXINGTON, TENN.—A. B. Lamb, of Paris, Tenn., and others are reported to have applied to the Council for a franchise to construct and operate an electric light plant and water-works system in Lexington. D. E. Aden, general manager of the Lexington Ice & Cold Storage Company, is also interested in the project.

CORPUS CHRISTI, TEX.—The County Commissioners have granted the Corpus Christi Street & Interurban Railway Company permission to extend its railway from Corpus Christi to the Epworth Encampment and the site of that large tourist hotel, to be built in the northern portion of the city.

CORPUS CHRISTI, TEX.—It is reported that plans are being prepared for the construction of a dam across the mouth of Nueces Bay by J. E. Franklin, president of the Uvalde & Crystal City Railroad Company. The proposed causeway will be about six miles long and from 200 to 250 feet wide across the top, in order to provide for interurban electric railway track, steam railroad, wagon road and automobile speedway. Spillways will be built to take care of the surplus flow of the stream which feeds the bay. The proposed reservoir would afford a perpetual supply of water for irrigating a large acreage of rich land and also provide sufficient amount of water to the City of Corpus Christi for all purposes. In connection with the water storage and irrigation project a hydroelectric plant will probably be installed to provide electricity for lamps and motors for this city and other towns. The cost of the reservoir is estimated from $750,000 to $1,000,000.

DENISON, TEX.—The Missouri, Kansas & Texas Railroad Company is planning to erect 674 miles of telephone lines to be used in dispatching trains. In addition, the company proposes to build about 2000 miles of telegraph lines, mostly in Texas.

FORT WORTH, TEX.—The Northern Texas Traction Company is reported to have prepared plans for the construction of a power house to be located on lower Calhoun Street, Fort Worth.

GALVESTON, TEX.—The Galveston-Houston Electric Railway Company has commenced work on the erection of its substation at South Houston.

KERRVILLE, TEX.—The contract for lighting the streets of the city has been awarded to the Kerrville Electric Light & Power Company.

SAN BENITO, TEX.—The interurban railway system, which is being built in the lower Rio Grande Valley by S. A. Robertson and associates, of San Benito, Tex., will be extended from this place to Mission, a distance of seventy-five miles.

OGDEN, UTAH.—Arrangements are being made by the Davis & Weber Counties Canal Company for the construction of a large power plant in connection with its irrigation system this year. The power house will be located south of Ogden, where 5000 hp will be generated. The stockholders have authorized an issue of $500,000 in bonds to provide funds for the work, which will include enlarging and lining of the main canal, building of a dam on Keber River at the upper end of the canal, erection of a power plant and enlargement of the East Cañon Creek reservoir. At present the system irrigates 12,000 acres and it is proposed to supply water to irrigate 30,000 acres.

SALT LAKE CITY, UTAH.—The State Legislature has passed the bill providing for appropriating $40,000 to install a power plant in Logan Canyon to furnish electricity for the state institutions and the Agriculture College.

RUTLAND, VT.—The Rutland Railway, Light & Power Company has made a slight reduction in the price of electricity for lamps. Under the new rate the price will be 14 instead of 15 cents for all energy consumed up to 2 kw-hours per month for each lamp and 7 cents instead of 7½ cents per kw-hour for all used in excess of that amount. The reduction was voluntary on the part of the company. The company is extending its lines north to the Scotch Hill and Bomoseen districts, a distance of six miles, and is also preparing to supply electricity in Pittsford for lamps. Plans are also being made by the company to extend its lines from Poultney to Granville through the slate quarry district in the near future, and for an extension of its electric railway from Fair Haven to Whitehall soon. The company also proposes to develop the Mill River properties in the near future. A 500-kw generator will be installed in the Carvers Falls plant within sixty days.

FALLS CHURCH, VA.—It is understood that a company has been organized with a capital stock of $100,000 to supply electricity for lamps and motors in Clarendon, Ballston, Cherryvale, Falls Church and other towns in Virginia. M. E. Church, of Falls Church, Va., is president, and L. L. Northrop, of Clarendon, Va., is secretary.

HAMPTON, VA.—The Newport News & Old Point Comfort Railway & Electric Company is reported to be contemplating making improvements to its power plant.

PULASKI, VA.—It is reported that plans are under way for the construction of a hydroelectric plant near Pulaski. It is understood that a tract of seventy-five acres embracing the site for a plant on New River has been purchased through O. L. Stearns, of Salem, Va.; options have also been obtained on other riparian lands. The syndicate which is interested in the development, it is stated, has agreed to purchase through Mr. Stearns, as agent, the electric plant located in Pulaski for a consideration of $25,000. The City Council will call for bids for a new franchise for lighting the city. The cost of the entire project is estimated at about $1,000,000.

RICHMOND, VA.—The Western Electric Company has been awarded the contract by the City of Richmond for supplying mast arms and other supplies for the municipal electric lighting system. The City Council recently revoked the contract held by Storms & Company for the overhead work.

CENTRALIA, WASH.—The Twin City Light & Power Company is planning to build an electric railway through the Chehalis and Big Balton section, which will require the construction of about ten miles of track.

CHELAN, WASH.—The Chelan Water Power Company is contemplating extending its transmission line to the lake shore, a distance of seven miles, to supply electricity for lamps and irrigating purposes. L. V. Harper is manager.

ORIENT, WASH.—Walter Bryant, of Orient, Wash., is reported to be interested in the erection of a power plant at Boulder Falls, three miles below here.

SOUTH PRAIRIE, WASH.—Demerest & Miller, of Tacoma, are reported to have purchased a saw mill at South Prairie, Wash., in which new machinery is being installed. The mill will be equipped for electric motor drive.

SPOKANE, WASH.—Preparations are being made by the Panhandle Electric Railway & Power Company for the construction of a hydroelectric power plant on Priest River, in Northern Idaho, capable of developing 30,000 hp, and the erection of a transmission line, seventy miles in length, from Priest River to Spokane, which will involve an expenditure of about $2,000,000. The company will apply to the City Council of Spokane for a franchise and has submitted a proposition offering to supply street lamps at the rate of $48 each per year, which is $12 less than the city now pays for the service; also to supply electricity to operate the up-river pumping station at $28 per hp per year, for which the city now pays $48 per hp per year. Victor M. Smith, of New York, N. Y., is interested in the company. Application has been made to the City Council of Hillyard, a suburb of Spokane, by the company for a fifty-year franchise, which if granted will give the company entrance to Spokane with its high-tension power-transmission lines.

BARABOO, WIS.—It is reported that S. S. Howell, of the firm of Chamberlain & Howell, of Chicago, Ill., has been engaged to prepare plans for the construction of a new lighting plant, which is to be installed by the bondholders of the Baraboo Light Company.

MISHICOT, WIS.—The installation of an electric light plant in Mishicot is reported to be under consideration. Ira Beyer is understood to be interested in the project.

PRESCOTT, WIS.—Bids will be received by the City of Prescott, Wis., until March 30, for construction of a gravity water-works system, including a 100,000-gal. reinforced-concrete reservoir, pump-house, one 20-hp motor and duplex of triplex pumps, water pipes, valves, etc. Plans and specifications may be seen at the office of the city clerk, Prescott, Wis., and at the office of the Oscar Claussen Engineering Company, National German-American Bank Building, St. Paul, Minn., consulting engineers. R. H. Price is city clerk.

WAUSAU, WIS.—The City Council is contemplating the installation of an electric generating plant in connection with the water-works pumping station to supply electricity for municipal purposes only. The Wausau Street Railway Company supplies electricity for operating the municipal lighting system at present. H. E. Marquadt is comptroller.

CHEYENNE, WYO.—The Cheyenne Light, Fuel & Power Company is contemplating improvements to its power plant this spring, including the installation of one 600-hp Franklin water-tube boiler and one 1000-kw, 2300-volt, three-phase, 60-cycle generator, direct connected to a Corliss engine. A. G. Langenbach is local manager.

CALGARY, ALTA., CAN.—The Alberta Electric Railroad Company, recently incorporated with a capital stock of $10,000,000, will soon begin work on the construction of a system of electric railways in southern Alberta.

LETHBRIDGE, ALTA., CAN.—Plans are being considered by the City of Lethbridge to install a 75-lamp, direct-current rectifier, set with either luminous or metallic-flame arc lamps, and to handle heating devices. Preparations are also being made to begin work on a municipal street railway system. The power-house equipment for the street railway system will include new boilers, alternating-current generating unit of about 1500 kva capacity and rotary converter. Arthur Reid is superintendent.

VANCOUVER, B. C., CAN.—The British Columbia Electric Railway Company is planning to extend its railway on Vancouver Island from Deep Cove to Victoria, a distance of about twenty-two miles. The cost of the construction and equipment of the proposed extension is estimated at about $500,000. F. R. Glover, of Vancouver, is manager.

BRANDON, MAN., CAN.—The Brandon Electric Light Company has submitted a proposition to the City Council offering to supply the city with electricity at the rate of $25 per horse-power per year, the service to begin Dec. 1, 1911; the plan submitted gives the city the right to purchase the plant any time within five years. The Council also has an offer from the E. B. Reese Company, of Winnipeg, for electrical service under consideration.

WINNIPEG, MAN., CAN.—It is understood that the City of Winnipeg will soon advertise for a manager for the municipal electric light plant now nearing completion. For further information address Cecil B. Smith, civic power expert.

WINNIPEG, MAN., CAN.—The City Council is reported to have voted in favor of purchasing the plants and holdings of the Winnipeg Electric Company, which controls the street railway, light, power and gas franchises in Winnipeg. It is understood that the city will have to pay approximately $16,000,000 for the system.

WINNIPEG, MAN., CAN.—Sealed tenders will be received by the chairman board of control, Winnipeg, Man., Can., until May 1, for furnishing ornamental lamp standards of approved designs. Plans and specifications and form of tender, with other necessary information, may be obtained at the office of the City Electrician, City Hall, Winnipeg, Man., Can. M. Peterson is secretary.

GUELPH, ONT., CAN.—The annual report of the Light and Heat Commission presented to the Council shows a net profit of $39,271 out of a total income of $98,117. The commission has decided to eliminate the meter rental for the future and reduce the price of electricity for lamps from 10 cents to 9 cents per kw-hour.

SAULT STE. MARIE, ONT., CAN.—The Lake Superior Paper Company, recently incorporated with a capital stock of $8,000,000, has purchased a site of twenty acres in the heart of the city, for which it paid the sum of $325,000. The company proposes to erect a new plant adjoining the Lake Superior Corporation's pulp mills, work on which will begin in the near future. The Lake Superior Paper Company is also contemplating the construction of a water-power canal to develop 60,000 hp.

THESSALON, ONT., CAN.—The town of Thessalon is contemplating the erection of a new power-house and installation of a new boiler and generator. John Elliott is chairman of Electric Light Commission.

TORONTO, ONT., CAN.—A bill has been introduced in the Ontario Legislature by W. W. McNaught which gives the Ontario Power Commission jurisdiction over the location of poles, wires, conduits and all equipment of municipal and private plants, and all persons dissatisfied may invoke the aid of the commission. The commission will also have power to order municipal wires attached to existing poles of private companies and may fix renumeration.

TORONTO, ONT., CAN.—An important amendment to the Provincial Hydroelectric Act has been introduced to the Ontario Provincial Legislature by Adam Beck, chairman of the Hydro-Electric Commission, providing for the supply of power to unorganized villages and farming districts throughout the province by the agency of the commission. The measure embodies the local improvement principle, in that it provides the means whereby only the portion of the municipality benefiting thereby pays the expense. Under the terms of the bill any resident or number of residents may apply to the Council of a municipality to enter into negotiations with the Hydro-Electric Commission. The Council must, after taking certain steps, enter into a contract with the commission to supply power to the applicants. The prices charged for the service shall be sufficient to return to the municipality the interest and the sinking fund upon the debentures.

MONTREAL, QUE., CAN.—The Montreal & Southwestern Railway & Power Company has been given authority by the Provincial Legislature to construct an underground terminus in Montreal and to build and operate an underground railway in Montreal, subject to the supervision of the Public Utilities Commission.

PENSE, SASK., CAN.—Bids will be received until April 1 by the Rufus Rural Telephone Company for the construction of a complete telephone system. F. R. Groves is secretary.

GUANAJUATO, MEX.—The Guanajuato Power & Electric Company is installing irrigating pumps upon farms in the central part of the State of Guanajuato. In the vicinity of Siloa transformers and motors to operate the irrigating pumping plants are being installed upon a number of farms by the company under the direction of Pable Rocha, local manager. The company also supplies electricity for lamps and motors for residents of the rural districts.

New Industrial Companies.

THE AMERICAN CURRENT MOTOR COMPANY, of Birmingham, Ala., has been incorporated with a capital stock of $2,000. The officers are: F. P. West, president; L. K. Mackey, vice-president; J. B. Russell, secretary, and D. M. Inman, treasurer.

THE ARNOLD-WAGNER COMPANY, of South Bend, Ind., has been incorporated with a capital stock of $10,000 to manufacture electrical supplies. The directors are: Earl H. Arnold, John W. Arnold and Joseph W. Wagner.

THE HIBBARD INDEX COMPANY, of Worcester, Mass., has been chartered with a capital stock of $50,000 to manufacture telephone indexes. W. E. Allen, of Cambridge, Mass., is president; J. A. Comstock, of Stoughton, Mass., vice-president, and B. F. Northbridge, of Worcester, Mass., treasurer.

THE MICA ELECTRIC SIGN COMPANY, of Cincinnati, Ohio, has been chartered with a capital stock of $10,000 by Hugh Mulholland, John H. Wilson, Robert Scannell, E. B. Rogers and T. E. Wilson.

THE NASSAU BURGLAR ALARM SERVICE, of New York, N. Y., has been incorporated with a capital stock of $100,000 to manufacture and install alarm systems and apparatus. The incorporators are: J. P. Conway, P. J. Muller, of New York, N. Y., and E. L. Vultee, of Rutherford, N. J.

THE PALO COMPANY, of New York, N. Y., has filed articles of incorporation with a capital stock of $5,000 for the purpose of doing a general contracting business and as electrical and mechanical engineers. The incorporators are: Edwin S. Lorsch, 2 West Eighty-ninth Street; Joseph P. Payor, 858 Hewitt Place, Bronx; Robert Steadle, 48 West Thirty-fifth Street, all of New York, N. Y.

THE POWER LAND & IRRIGATION COMPANY, of Portland, Maine, has been incorporated with a capital stock of $500,000. The company proposes to construct reservoirs, dams, power plants, irrigation works, etc. C. E. Eaton is president and A. F. Jones, treasurer, both of Portland, Maine.

New Incorporations.

PAINTSVILLE, KY.—Articles of incorporation have been filed for the Paintsville Water & Light Company with a capital stock of $20,000 by H. M. Stafford, John E. Buckingham, S. Oppenheimer and others.

PORTLAND, MAINE.—The United Power & Light Company has been incorporated with a capital stock of $5,000 by M. S. Wells, H. L. Cram, C. E. McGlaulin, of Portland, Maine.

NEW YORK, N. Y.—The Westchester & Northern Railway Company has been incorporated to construct an electric railway from the White Plains terminal of the New York, Westchester & Boston Railway northward to Brewster and Danbury. A branch will also be built to Lake Waccabac and Lake Maliopac. Surveys have already been made for the proposed railway.

YONKERS, N. Y.—The Citizens' Electric Light, Heat & Power Company has been incorporated with a capital stock of $100,000 by Joseph L. Schwartz, Gideon H. Peck, Uriah Harris, Michael Lally, David J. Keith and others. The company proposes to construct and operate an electric light plant in Yonkers, N. Y.

Personal.

MR. FREDERIC GREER, president of the Harvard Electric Company, of Chicago, has been appointed a member of the Civil Service Commission of Cook County.

PROF. W. T. RYAN, of the electrical engineering department of the University of Minnesota, delivered an address on "High-Frequency Currents" before the Minneapolis Electric Club.

MR. W. S. LEE, chief engineer of the Southern Power Company, has been elected vice-president and chief engineer of the Greenville, Spartanburg & Anderson Railway, Greenville, S. C.

MR. FRANK K. SHUFF has resigned from Iowa State College to become superintendent of the Boone (Ia.) Electric Company, which operates the railway and lighting properties in Boone.

MR. LOUIS A. FERGUSON, second vice-president of the Commonwealth Edison Company, Chicago, is in Hot Springs, Va., with his family, enjoying an extended springtime vacation.

DR. S. W. STRATTON, director of the Bureau of Standards, will represent the United States government at an international convention on weights and measures to be held at Paris, beginning March 29.

MR. FRANK EASTON, recently deputy state engineer of Colorado, has become connected with the plant service department of the Western Union Telegraph Company, under Mr. Whitehead, division manager.

MR. J. S. KIRKPATRICK, formerly of the New York & Queens Electric Light & Power Company, Long Island City, has been appointed new business manager of the Eastern Pennsylvania Power Company, Easton, Pa.

MR. CLARENCE E. DELAFIELD has been appointed district manager for the Crocker-Wheeler Company in New England, with headquarters at 201 Devonshire Street, Boston. Mr. Delafield succeeds Mr. R. N. C. Barnes, who recently resigned.

MR. J. T. COWLING, head of the electrical department of the Westchester Lighting Company, Mount Vernon, N. Y., has been granted a leave of absence and will spend a month or more in Los Angeles, Cal., where he has gone for a much needed rest.

MR. RICHARD PAULING has arrived in Charlotte, N. C., from Germany to be present during the installation by the Southern Power Company of an equipment for manufacturing fertilizer by means of an electrostatic nitrogen fixation process in which he is interested.

MR. HENRY FLOY has just returned to New York from inspection of the Panama Canal. Mr. Floy was of the party made up by the American Society of Civil Engineers, which left New York on the steamer *Zacapa* for a three weeks' trip to Jamaica and the Canal Zone.

PROF. GEORGE ALFRED GOODENOUGH, for many years associate professor of mechanical engineering in the University of Illinois, has been promoted to be professor of thermodynamics. He is a graduate of Michigan Agricultural College and has written several text-books.

DR. GEORGE L. HOXIE, electrical engineer, New York, has been retained by the Board of Public Utilities of the City of Los Angeles to act as a member of a board of consulting engineers to advise on the fixing of rates for electrical energy for lighting and motor service.

MR. E. H. THORDARSON, of the Thordarson Electric Manufacturing Company, of Chicago, is on a visit to the East. Mr. Thordarson is taking advantage of the occasion to visit antiquarian book shops in order to make additions to his extensive collection of books on Iceland and the natural sciences.

MR. FRED HUME has been appointed superintendent of machinery of the Fort Dodge, Des Moines & Southern Railroad Company, Boone, Ia. Mr. Hume will have charge of the power house, transmission lines, substation and all matters pertaining to the operation and maintenance of electrical and mechanical equipment.

MR. FREDERIC W. HILD has been appointed general manager of the Portland Railway, Light & Power Company, Portland, Ore. Mr. Hild is a graduate of Union College, Schenectady, N. Y., and was until his present appointment chief engineer and assistant general manager of the Havana Electric Railway Company.

MR. H. B. STABLER, plant engineer for the Washington Division of the Chesapeake & Potomac Telephone Company, read a paper at the March meeting of the Baltimore Section of the American Institute of Electrical Engineers, held in the physical laboratory of the Johns Hopkins University, on "The Distribution System of a Telephone Plant."

MR. FRED E. GREENMAN, who had immediate charge of the construction and initial operation of the pioneer 110,000-volt transmission line of the Grand Rapids-Muskegon Power Company, Grand Rapids, Mich., left the electrical field in 1909, and is now assistant engineer for the Griffin Car Wheel Company, with offices at Chicago, Ill.

MR. GEORGE A. DAMON, of the Bion J. Arnold Engineering Company, lectured before the students of Throop Polytechnic Institute, on March 13, on the subject of "Transportation Problems," with special reference to the Pittsburg situation. Mr. Damon is at present engaged in an appraisal of the properties of the Southern California Edison Company.

MR. H. G. STOTT, past-president of the American Institute of Electrical Engineers and superintendent of motive power of the Interborough Rapid Transit Company, New York City, was tendered a banquet by the members of his staff recently at the Hotel Ansonia in commemoration of the tenth anniversary of his connection with the company.

MR. GEORGE D. PERRY, secretary-treasurer of the Great Northwestern Telegraph Company of Canada, has been appointed general manager of the company, succeeding Isaac McMichael, who died two weeks ago. Mr. Perry has been with the company since its organization, having filled the positions of stenographer, accountant, secretary, auditor and secretary-treasurer.

MR. WERNER F. VON SIEMENS, of Berlin, Germany, is on a visit to this country, during which he will inspect some of our more important metallurgical plants. Mr. von Siemens is accompanied by Chief Engineer Maleyka of the Siemens-Schuckert Werke and by Dr. J. Puppe. Dr. Puppe has been commissioned by the German Electric Railway Association to make a study during his visit of the causes of rail corrugation.

MR. S. E. DOANE, chief engineer of the National Electric Lamp Association, addressed the Engineers' Club of Cleveland on Tuesday evening, March 14, at the Chamber of Commerce. Mr. Doane spoke on "The Value of Co-operation in Engineering" and his talk was illustrated by lantern slides, showing how the standardization of materials in the incandescent-lamp industry has been made possible through co-operation.

MR. F. F. BARBOUR has been appointed assistant to the president of the Pacific Gas & Electric Company, San Francisco, Cal., in which capacity he will manage the railway system of the Sacramento Electric, Gas & Railway Company, Sacramento, Cal., and the commercial department of the Pacific Gas & Electric Company. Mr. Barbour was formerly assistant to the president of the Portland Railway, Light & Power Company, Portland, Ore., and was at one time special agent of the General Electric Company at San Francisco.

MR. ERNEST L. CLARK, president of the Valentine-Clark Company, was the guest of honor at a farewell dinner given in his honor on March 14 at the College Inn, Chicago, prior to his departure for Minneapolis, to which city his company has transferred its headquarters. Mr. Clark's popularity is shown by the fact that many of his principal business competitors attended the dinner and extended their good wishes. Mr. Clark, who is a former president of the Northwestern Cedarmen's Association, is a prominent figure in the cedar-pole industry.

MR. J. P. CLARK, vice-president and general manager of the Greenville, Spartanburg & Anderson Railway, Greenville, S. C., who has been acting as expert and consulting engineer to Mr. J. B. Duke, president of the company, in connection with the developments being carried out by Mr. Duke and his associates in North and South Carolina, will continue to act in the capacity of consulting engineer in this connection. Mr. Clark is also managing director of the North Carolina Public Service Company, Greensboro, N. C., and retains his connection with the Michigan United Railways, Lansing, Mich., as vice-president.

PROF. CHARLES RUSS RICHARDS, dean of the College of Engineering of the University of Nebraska, has been appointed professor of mechanical engineering, in charge of the department at the University of Illinois, effective September 1, 1911. Born in Indiana in 1871, Professor Richards graduated from Purdue in 1890. He received the graduate degree of mechanical engineer from the same university a year later and the degree of master of mechanical engineering from Cornell in 1895. He has been teaching at the University of Nebraska since 1892. A paper written by him on the heating value of corn and presented before the American Society of Mechanical Engineers some years ago when Western farmers were burning their corn attracted wide attention.

MR. P. T. GLIDDEN, formerly vice-president and general manager of the Binghamton Light, Heat & Power Company, Binghamton, N. Y., has been elected vice-president and manager of the Eastern Pennsylvania Power Company, Easton, Pa., which is controlled by the same interests. The Eastern Pennsylvania Power Company controls and operates the local companies formerly known as the People's Electric Light & Power Company and the Easton Steam Heating Company, and also the Bangor Electric

Light, Heat & Power Company, Bangor, Pa.; Dover (N. J.) Electric Light Company, Rockaway (N. J.) Electric Light & Improvement Company and the Warren County Power Company, Columbia, N. J. The company also operates the Monroe County Water Power & Supply Company, Stroudsburg and East Stroudsburg, Pa.

Obituary.

MR. FRANK KAISER, superintendent of the electric-light company at Mott, N. D., was found dead in the plant Wednesday, March 15, alongside his dog, both having been asphyxiated as a result of inhaling gas fumes present in the station.

MR. JOHN B. McDONALD, the contractor who built the New York subway, died at his home in New York on March 17 after an illness of several weeks. Mr. McDonald was born at Fermoy, County Cork, Ireland, in 1844. He was brought to America by his parents in 1848. Almost all of his active life was spent at contracting, his earliest work along this line being with his father, who was a small contractor. In 1872 he was chief inspector of the Park Avenue tunnel work in New York. As contractor he conducted work for the West Shore, Illinois Central, Baltimore & Ohio, Boston, Hoosac & Western, Canadian Pacific, and Delaware, Lackawanna & Western railroads, the belt line in Baltimore, and the Jerome Park reservoir in New York. Although he never attended college, the honorary degree of Doctor of Science was awarded him by the University of Kingston, Canada, in 1905 shortly after the New York subway was opened.

Trade Publications.

INTERPOLE MOTORS.—Circulars Nos. 36, 37 and 38, containing revised information, descriptions, ratings and applications of interpole motors, have been issued in a single binding by the Electro-Dynamic Company, Bayonne, N. J.

ELECTRIC-VEHICLE METERS.—The Sangamo Electric Company, Springfield, Ill., has issued Bulletin No. 24, devoted to ampere-hour electric vehicle meters. The theory and application of these meters is discussed, and the pamphlet should prove of interest to central-station managers interested in the electric vehicle.

INSTRUMENTS AND METERS.—The Fort Wayne Correspondence School, Fort Wayne, Ind., has issued a catalog giving an outline of its course on instruments and meters, as well as a general statement of the purposes of the school. The course which the school gives on instruments and meters is said to be indorsed by the leading electrical men of the country.

DISTRIBUTION CURVES.—Distribution curves and full detailed reports of the Electrical Testing Laboratories of New York on four-lamp shop clusters and shop units, built by the American Arc Lamp Company, Kalamazoo, Mich., have been reproduced in book form by the latter company for distribution to electrical engineers, electricians and others interested in the subject.

ELECTRICAL SUPPLIES.—The Mohawk Electrical Supply Company, Syracuse, N. Y., has issued Booklet No. 2, stating in general the class of electrical merchandise which it carries in stock and for which it solicits orders. The line includes central station and line equipment, telephone supplies, bell wiring and automobile supplies, electric heating and cooking material, portable and stationary vacuum cleaners, etc.

FAN MOTORS.—The Robbins & Myers Company, Springfield, Ohio, has issued its fan catalog No. 94, devoted to "Standard" direct-current and alternating-current ceiling, desk, oscillating and exhaust fans. The "Standard" fans have now been marketed for fifteen seasons, and are noted for their qualities of durability, efficiency and artistic design. The line is complete in every particular, and includes fans for every purpose and purse.

SHOP-LIGHTING FIXTURES.—The American Arc Lamp Company, Kalamazoo, Mich., has issued Bulletin No. 44, comprising a catalog of clusters and fittings for shop lighting, and shock absorbers for tungsten lamps. The latter are interchangeable and may be used with any of the clusters or units. The former are of steel, with porcelain enamel or steel shades, and are fitted with tungsten lamps. They are fully wired and furnished with ceiling crowfoot or absorber.

LIGHTNING ARRESTERS.—The Electric Service Supplies Company Philadelphia, Pa., has bound into a single publication bulletins Nos. 48, 49, 50, 51, 53, 54 and 55, dealing with the Garton-Daniels lightning arresters for direct-current and alternating-current circuits. The bulletins have been revised, and not only contain very good descriptions of the operation and construction of the particular types of apparatus, but also give complete diagrams of installations for arc circuits, direct-current circuits of voltages up to 1300, alternating-current circuits of voltages up to 20,000 and railway circuits.

HYDRAULIC TURBINES.—Bulletin 102, issued by the S. Morgan Smith Company, York, Pa., manufacturers of water turbines, contains a quantity of information relating to the setting of water wheels, illustrating various applications of the turbines made by the company, to practical conditions of head, dam construction and intake flumes. Smith turbines are built to operate under a range of heads from 3 to 47 ft. and can be furnished in several speeds, and with cylinder or wicket gates. The installations described and illustrated in the bulletin relate to hydroelectric developments, mill drives, etc.

BUSINESS NOTES.

THE MITCHELL-RAND MANUFACTURING COMPANY will move on March 25 to its new offices in the Phelps-Dodge Building, 99 John Street, New York.

WALKER VEHICLE COMPANY.—The Automobile Maintenance & Manufacturing Company announces the change of its name to Walker Vehicle Company. The company manufactures electric commercial vehicles, using the Walker balance-drive gearing. Its address is 217 South Green Street, Chicago.

BUCKEYE LAMP MEXICAN OFFICE.—The office in Mexico City of the Buckeye Electric Lamp Company has been moved from Avenue 16 de Septiembre No. 5 to Avenue Juarez No. 14. Mail matter for the Buckeye Electric Lamp Company of Mexico City, should be addressed Apartado Postal No. 746. Mr. Walter Ennes is manager of the Mexican office.

THE RICHARDSON-PHENIX COMPANY, of Milwaukee, Wis., has recently opened a branch office in the Keystone Building, 324 Fourth Avenue, Pittsburgh, Pa., under the management of Mr. H. H. Laughlin, who has been with the Richardson-Phenix Company for several years. Questions concerning the economical lubrication of any kind of machinery can be given personal attention by Mr. Laughlin.

STUDENTS VISIT TRIUMPH WORKS.—A delegation of third-year students from the Kentucky State University, Lexington, Ky., visited the plant of the Triumph Electric & Ice Machine Company on Wednesday, March 15, and were conducted through the plant by employees, who explained the various methods of manufacture. The visitors were particularly interested in machine-tool design and had selected the Triumph company as part of their itinerary on account of the modern and up-to-date equipment employed in these shops. After a most instructive and pleasant time, the students left on a late afternoon train en route for Hamilton to inspect some of the large factories in that city.

BISSELL CHICAGO OFFICES.—The Bissell Motor Company has opened two offices in Chicago. Of these one is at 33 East Munroe Street, opposite the Palmer House, with E. J. Fisher in charge as manager. This is on the ground floor, and has a show window for demonstrations of the Bissell sewing machine motor. The other is at 512 Monadnock Block, from which a staff of canvassers will be directed. In the campaign thus opened in Chicago in the interests of the Bissell sewing machine motor, department stores and sewing machine dealers selling Bissell motors will be supported. Eugene Willoughby, recently with the Chicago Independent Telephone Company, has been appointed general manager of the Bissell Motor Company. Mr. Willoughby's headquarters are temporarily in Chicago, 512 Monadnock Building, but will be shortly moved to the factory at Toledo.

THE BURKE ELECTRIC COMPANY, Erie, Pa., marked the opening of a large new factory building, February 22, by tendering a complimentary dance and banquet to its employees and friends. The new building, 338 x 50 ft., which will be used for the storage of finished parts and for assembling, testing and shipping, was decorated in honor of the occasion and was used as the dancing pavilion. Exhibits of the varied lines of generators, motors, transformers, drills and apparatus manufactured by the Burke company were laid out in the other shops of the factory and were viewed by altogether about 3,000 people during the day. The officers of the Burke Electric Company are: President, James Burke; vice-president, George H. Winkler, Jr.; treasurer, G. Irving Blake; secretary, Charles H. Schum; works manager, E. F. G. H. Faure. Mr. Isidore Hernsheim is chairman of the board of directors.

THE FEDERAL ELECTRIC COMPANY, Lake and Desplaines Streets, Chicago, on March 1 completed arrangements whereby the sale of goods manufactured by the company will be handled exclusively by the Federal Sign System (Electric), as selling agents. The latter corporation has main offices at 501 Home Insurance Building, Chicago, and 229 West Forty-second Street, New York City, with branch offices in fourteen other large cities. The Federal Electric Company will in the future conduct the manufacturing end of the business exclusively. The company will continue the manufacture of Federal signs, fixtures, supplies, vacuum cleaners, electric kitchen cabinets and other Federal specialties. The regular representatives of the Federal Electric Company will continue as agents of the Federal Sign System (Electric), and the selling force of the Federal Electric Company will be transferred to the selling corporation.

NEW G. E. NEW YORK CITY WAREHOUSE.—A large and commodious fireproof warehouse building, of modern steel and concrete construction, has just been completed for the General Electric Company at the corner of Greenwich and Morton Streets in New York City. This handsome new building is more than twice the size of the present quarters, at 24-27 West Street, where the company's warehouse has been located for the past twenty years. The building, which will be ready for occupancy about April 1, has nine floors, aggregating 90,000 square feet of floor space, and providing ample space for storing the numerous electrical appliances manufactured by the General Electric Company. Steel bins and racks, of a special pattern, have been installed for the accommodation of loose stock, etc. Two freight elevators will be used to handle the freight and express, insuring the speediest shipping facilities. Another elevator will transport passengers from floor to floor. The increased floor space and improved shipping facilities will enable the company to carry a much larger stock to meet the demands, which have grown far beyond present accommodations. The new building is located near the shipping center of New York and close to the principal steamboat piers.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED MARCH 7, 1911.

[Conducted by W. F. Bissing, Patent Law, 2 Rector St., N. Y. City]

986,396. CABLE TELEGRAPH APPARATUS; I. Kitsee, Philadelphia, Pa. App. filed May 21, 1909. A telegraph relay with siphon recorder whose movable coil moves a delicate contact controlling a plurality of sources of energy causing reproduction of clear signals irrespective of the shifting zero.

986,405. TRANSMITTING APPARATUS FOR WIRELESS TELEGRAPHY; P. O. Pedersen, Copenhagen, Denmark. App. filed March 6, 1907. An oscillation circuit for producing continuous oscillations, an antenna circuit, a compensation circuit and a key to alternately connect the antenna and compensating circuit to the oscillating circuit.

UNITED STATES PATENTS ISSUED MARCH 14, 1911.

986,463. SELF-ADJUSTING FUSE; J. O. Holton, Jr., Monett, Mo. App. filed Jan. 20, 1910. Fuse and lightning arrester avoiding the cleaning out of carbon dust after electrical storms by providing a special form of fuse block and by replacing a fuse, the overcharge being conducted to ground during replacement of a fuse by means of a choke coil which deflects the overcharge to ground while the automatic successive fuse is operated.

986,488. ELECTRIC IRON; R. P. Moodie and C. W. Ball, Ottawa, Ontario, Canada. App. filed Aug. 14, 1908. Electric sadiron with cylindrical recesses for the heating coils, hollow cores carrying the heating conductors inserted therein.

986,505. PROCESS FOR PRODUCING ALLOYS OF TITANIUM WITH OTHER METALS OR THE LIKE; A. J. Rossi, Niagara Falls, N. Y. App. filed May 6, 1910. Produces on the surface of a bath of molten copper a covering comprising oxid of titanium, carbon and a chemical compound of calcium and raises to a temperature to reduce the oxide.

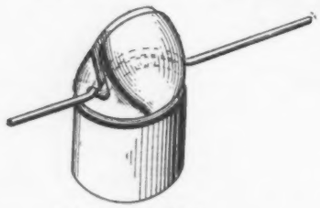
986,506. PROCESS OF COUPLING PIPES; F. Sargent, Chicago, Ill. App. filed Nov. 3, 1910. The joint is sealed by welding the abutting ends together, while held by a mechanical clamp.

986,554. MAGNETIC SEPARATOR; A. Dings, Milwaukee, Wis. App. filed March 6, 1907. Electro-magnetic separator with a shaft connected to a carrier wheel which carries an annular series of magnetizable members serving as auxiliary pole pieces, a conveyor of less width than the diameter of the wheel extending across one face of it, and sets of electro-magnets straddling the conveyor and having polar projections extending inwardly and toward the conveyor.

986,558. METALLIC FILAMENT FOR INCANDESCENT ELECTRIC LAMPS; K. Farkas, New York, N. Y. App. filed Aug. 6, 1909. The filament has an inner conductor core and the coating is applied by decomposing with the electric current vapors of a compound of high refractory metal mixed with the vapors of a salt of a ductile metal and vapors of pyro gallol.

986,570. IRON-CLAD ELECTRIC SWITCH; V. Hope, Manchester, England. App. filed Aug. 10, 1909. The switch blades act independently of the handle with a quick action by means of a coiled tension spring between blades and handle. Details.

986,606. TELEPHONE BODY SUPPORT; V. Tardieu, Arles, France. App. filed Nov. 29, 1909. For suspending microphones by means of a bridle mounted on the head. Details.



986,702.—Insulator.

986,639. SELECTIVE SIGNALING MEANS; I. F. Manny, Milwaukee, Wis. App. filed Nov. 29, 1909. For telephone systems operated from central to call a station, by means of a motor-driven mechanism detained by a magnet-controlled pawl, starting a step-by-step mechanism.

986,643. ELECTRIC RELAY; C. O. Poor, Rochester, N. Y. App. filed Aug. 10, 1908. For electric railways, all the parts being within a casing, excepting the fixed contacts which are removably mounted on top for cleaning.

986,651. SPACE TELEGRAPHY; J. S. Stone, Boston, Mass. App. filed March 12, 1908. Arranges an electrolytic receiver in a shunt to a condenser, forming a resonant circuit tuned to the wave frequency.

986,702. INSULATOR; D. H. Friend, Canton, Ohio. App. filed May 24, 1910. For supporting telegraph wires by insulator with an annular groove on its under surface and a cone-shaped slotted head.

986,706. ELECTROTHERMOSTATIC ALARM SYSTEM; A. Goldstein, New York, N. Y. App. filed Aug. 6, 1910. Gives an audible alarm at station and central by producing a high-frequency current and actuating two alarm devices, one responsive to the said current, the devices being in the nature of loud-speaking telephones.

986,707. ELECTRICAL CIRCUIT CONTROLLER AND ALARM; A. Goldstein, New York, N. Y. App. filed Aug. 6, 1910. Imposes a frequency on the circuit for producing an audible alarm signal controlled by a thermostat, the apparatus upon increase in current giving a local alarm and producing the frequency for operating the distant device.

986,708. AUTOMATIC CIRCUIT BREAKER; A. E. Greene, South Boston, Mass. App. filed June 12, 1905. Switchboard circuit breaker operated manually with a single magnetic control responsive to overload and underload, there being a tripping armature for the catch and a latch operated by the armature, the armature and latch receiving the catch for retaining the circuit breaker between them.

986,714. ELECTRIC SWITCH; H. Hull, Denver, Colo. App. filed June 15, 1909. For animal traps to fire an explosive cartridge when the animal snaps the bait.

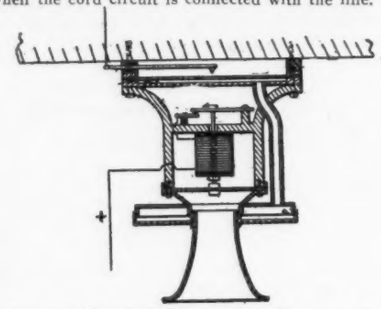
986,715. GAS ALARMS; A. B. Jacobus, Kansas City, Mo. App. filed Nov. 24, 1909. Gives an alarm when the room fills with gas by means of a battery and magneto controlled by chamber provided with a flexible diaphragm.

986,743. SOCKET FOR ELECTRIC GLOW LAMPS; T. E. Murray, New York, N. Y. App. filed July 24, 1909. The socket is cup-shaped and integral of a single piece of porcelain and has openings for the circuit wires so constructed as to prevent access thereto after the parts are in place.

986,744. ELECTRIC CUT-OUT; T. E. Murray, New York, N. Y. App. filed Oct. 25, 1910. Cut-out box comprising a base block, a fuse case, a detachable cover for the block between the block and the case, contacts on base and cover and a fuse connected to the cover contacts.

986,748. DYNAMO-ELECTRIC MACHINE; C. M. Page, Chicago, Ill. App. filed May 2, 1910. The machine has an armature and can be used either as a generator or motor, there being two electrically independent field windings, either of which may be used for the particular purpose desired, with a double throw switch for controlling the windings.

986,787. TELEPHONE SYSTEM; A. H. Weiss, Chicago, Ill. App. filed March 30, 1907. Controls a central office signal by means of a single relay with an intermediate degree of actuation to display a signal when the subscriber calls central, which is completely actuated to efface the signal when the cord circuit is connected with the line.



986,707.—Electrical Circuit Controller and Alarm.

986,806. REFLECTOR FOR WIRELESS TELEGRAPHY; R. d'Antonio, Aquila, Italy. App. filed Jan. 27, 1910. The reflectors maintain a horizontal plane, irrespective of the angle of the deck of the vessel by means of ball bearings and counter weights.

986,823. ELECTROPLATING MACHINE; J. W. Heaphy, Philadelphia, Pa. App. filed June 30, 1910. Horizontally supported rotary casing for containing the solution, there being an anode in the casing rotatable in unison with the work support in opposite direction to the casing.

986,842. TROLLEY; J. S. McCabe, Bridgeville, Pa. App. filed Jan. 24, 1910. Trolley harp has a guard forming jaws between which the wire runs the jars being provided with frictional wheels which contact with the wire and special lubricating means and a hollow bearing for the trolley wheel.

986,843. HANGER FOR TROLLEY WIRES; W. A. McCallum, Cincinnati, Ohio. App. filed May 19, 1910. To provide a yielding upward structure for suspending the wire from the cable. The cable carries brackets from which toggle levers depend, at the joint of which is secured a support for the trolley wires.

986,845. ELECTRICAL WELDING MACHINE; E. E. McIntyre, Pittsburgh, Pa. App. filed Sept. 23, 1910. For welding pulleys; the welders are kept in engagement with the work under a state of compression.

986,887. LOCK FOR SWITCHES; G. Wuelser, New Kensington, Pa. App. filed June 18, 1910. Combination lock for switches. Details.

986,889. SECRET SERVICE TELEPHONE CIRCUITS AND SWITCHING MECHANISM; A. K. Andriano, San Francisco, Cal. App. filed March 15, 1905. A home line for each station, a common return for a plurality of stations, a primary circuit with line-selecting switch at each station and a circuit-connecting device connecting primary with current source through the home line and cutting out the home line and connecting the primary to the line-selecting switch in another position, a ringing circuit over the home line.

986,952. LOCKING DEVICE FOR TELEPHONES; W. A. Soles, New York, N. Y. App. filed April 22, 1910. Locks the hook for the receiver to prevent unauthorized use by means of a brace engaging hook and support and a lock for holding the brace against removal from the switch lever.

986,958. ELECTRIC SWITCH; C. Woods and W. H. Sayles, Peoria, Ill. App. filed Dec. 18, 1908. Door switch for elevator cars fo breaking the motor circuit when the door is open by means of a pivoted arm controlling terminals and a push rod, operated by the door.

986,991. PULL CHAIN GUIDE FOR SOCKET. O. E. Kenney, Toledo, Ohio. App. filed Jan. 6, 1911. The chain guide may be attached radially to the socket shell, or tangentially.

987,036. SAFETY COUPLING FOR ELECTRIC CONDUCTORS; A. Belgoder, Mexico, Mexico. App. filed May 26, 1909. The sections of the wire are connected by a coupling which is automatically uncoupled when any section is broken to avoid danger to persons.

987,044. DYNAMO-ELECTRIC MACHINE; J. Burke, Erie, Pa. App. filed May 1, 1907. For supplying a three-wire, direct-current system by means of a direct-current generator, having a plurality of auxiliary dynamo windings on the armature core, each of the auxiliary windings having less than one-half of the conductors per circuit of the main winding, certain conductors of the auxiliary windings being located unsymmetrically to each other.

987,058. APPLE BAKER; W. F. Fowler and Charles H. Mead, Indianapolis, Ind. App. filed Nov. 22, 1909. An electrical apple baker with disk and vertical posts, the electrical resistance wire being embedded in the posts.

987,072. RAIL BOND; G. A. Humason, Shreveport, La., and E. F. Odell, Greenville, Tex. App. filed March 19, 1910. Rails with their ends close together and having contacts, a key inserted between them and resilient members between the contacts and the rail.